

PARSONS BRINCKERHOFF - TUDOR - BECHTEL

General Engineering Consultant To

San Francisco Bay Area Rapid Transit District

413 Market Street

May 2, 1960

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## SAN FRANCISCO

### BAY AREA RAPID TRANSIT DISTRICT

Mr. Harold M. Hoover  
San Francisco Bay Area  
Rapid Transit District  
413 Market Building  
San Francisco, California

Dear Mr. Hoover:

We discussed with you earlier in the year and stated in our letter of January 7, 1960, submitting for approval a revised engineering report that it has not been possible to reach full agreement with the various agencies on the routing of the regional transit system. The program for the regional transit system was approved by the District on February 2, 1960.

#### WORKING ESTIMATES

#### MAY 2, 1960 ROUTES

We submit herewith certain estimates of the cost of the regional transit system as of May 2, 1960. These estimates are based on the first stage of the program. Following the request of the Mayor's Transportation Study of the City of San Francisco, the most significant addition is the San Francisco Line extending from Daly Avenue in San Francisco to Daly City. In addition, there have been some changes to the system. Considerably more work has been done than was

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## II. ROUTE SELECTION AND DEVELOPMENT

### A. GENERAL

In determining the alignment and type of construction of the routes, use was made of available data: such as local maps, U. S. Geological maps, U. S. Coast and Geodetic maps, zoning and master plans, boring records, utility plans, and building plans. Route corridors were photographed aerially, and up-to-date aerial maps were prepared. Through the use of these maps and through on-the-site field investigations, the lines were developed in plan and profile.

Typical structures were designed for surface, aerial, and underground construction. These were adapted to the selected lines and grades. Where unusual conditions were encountered, modifications were made.

The project and routes were discussed with the authorities concerned and their technical staffs. By continuous research and collaboration, the lines have been improved and refined, and a large measure of acceptance has been obtained.

There are, however, a number of locations where divergence of opinion exists as to route and/or type of construction. It has been necessary to carry forward several alternatives, some of a major nature, to full development and estimate for later negotiation and decision. Development and estimates for these alternatives are underway and are not included herein.

### B. ROUTE DESCRIPTION

These May 2, 1960 working estimates are based upon routes that are depicted on the map entitled "General Map, May 2, 1960 Routes". These routes are not our final recommendation but represent the system that was outlined in our letter of February 9, 1960 as the system to be estimated first. Other estimates are to follow. Changes, extensions, cutbacks, and substitutions of alternative routes and types of construction can be expected in the process of formulating a final system.

1. San Francisco Downtown -- The downtown area of San Francisco is connected to all other parts of the system by four lines; the Trans-Bay Tube to Oakland and the East Bay area, the Marin Line to Marin County, the Twin Peaks Line to southwestern San Francisco and Daly City, and the Peninsula Line to San Mateo County and Santa Clara County.

The Trans-Bay Tube and the Twin Peaks Line form northeast and southwest extensions of the alignment of Market Street, the major business and transportation axis of San Francisco. The downtown section of the Twin Peaks Line originates at the Gateway Station, which is located beneath Davis Street near Clay Street, and proceeds south in subway to Market Street. After entering Market Street it continues westward in subway and includes the Castro Street Station near the eastern portal of the Twin Peaks tunnel. Stations along Market Street are located at Montgomery Street, Powell Street, Civic Center, Van Ness Avenue, Church Street, and Castro Street.

The downtown section of the Marin Line begins at an underground terminal in Post Street at Market Street and extends westward in subway along Post Street to Laguna Street. Stations included in this section are located at Kearny Street, Union Square, and Van Ness Avenue.

The downtown section connecting the Trans-Bay Tube and the Peninsula Line joins the Tube approach at the eastern end of the Montgomery Street Station in Market Street. The line continues westward in subway under Market Street and turns south into Ninth Street to Division Street. From there, it generally follows the Western Pacific Railroad to the northern entrance of a proposed tunnel under Potrero Hill. Stations in this section are located at Montgomery Street, Powell Street and Civic Center.

All construction in San Francisco Downtown is planned as subway, and all stations have mezzanines. A four-track, two-level subway is planned in Market Street in the section where the Peninsula, Trans-Bay and Twin Peaks lines are common. The lower level carries the Peninsula and Trans-Bay tracks, and the upper level carries the Twin Peaks tracks.

A continuous mezzanine is proposed in Market Street between the Montgomery Street and Civic Center stations, and between the Union Square and Kearny Street stations on Post Street. This assures good distribution of passengers to the street level without undue congestion. Actually many buildings may ultimately connect directly to the subway mezzanine. Valuable side effects could result, such as the easing of pedestrian street crossings. The desirable development of some type of underground business street for pedestrians might also be anticipated.

A four-track single-level subway was also studied for Market Street. This structure has some advantages, particularly on lower Market Street, in that the dewatering and excavation problems are less severe. This subway does, however, have the serious disadvantage of occupying most of the street width, including sidewalks, particularly at the station sections; and has additional adverse effects on utilities and maintenance of street traffic and pedestrian traffic.

Several terminal locations and routes for the Marin Line were considered, including alignments on Ellis, O'Farrell, Geary and Sutter Streets as well as the original Kearny-Columbus-Lombard Street Route. Ellis and O'Farrell Streets permit better profiles but afford poorer delivery to Market Street and offer more difficulty in connecting with Geary Boulevard, the preferred street to the West. A Geary Street location encounters opposition and potential construction difficulties in the Western Addition now under redevelopment. Post Street offers the most advantages of delivery and route.

The original Kearny Street terminal location for the Marin Line was eliminated largely due to the change from Lombard Street to Geary Boulevard as described under Marin Line-San Francisco County; and also due to the change in the Trans-Bay Tube approach to align it with Market Street.

An alignment in Seventh Street, Leavenworth Street and Post Street--the so-called Leavenworth Loop--was considered for the Peninsula-Trans-Bay connection, particularly at the urging of the City. This route would shorten the length of the two-level subway in Market Street but at the cost of a two-level subway in narrow Post Street where the Peninsula Line would join the Marin Line. It was considered neither feasible nor prudent to attempt to combine the Peninsula and Trans-Bay Lines and the Marin Line on the same two tracks. Then, too, the Leavenworth Loop would not serve Market Street at Powell Street.

Instead of a Twin Peaks full rapid-transit line, the alternative of adapting the present streetcar line to a form of rapid transit is still under study. This scheme utilizes the subway upper level as a streetcar right of way through the congested downtown area. A restricted zone or reservation could be provided on Market Street in the section between the subway entrance and the Twin Peaks Tunnel by eliminating some surface-traffic crossings. Service and commuting time compare very favorably with a full rapid-transit line, and this plan is obviously less costly.

An alternative Peninsula Line utilizing generally the Mission Street-Bernal Cut route which was the original 1955 route, is under intensive study and estimate.

2. Twin Peaks Line -- The Twin Peaks Line leaves San Francisco Downtown via a subway under Market Street and a tunnel beneath Twin Peaks. For purposes of this estimate, the Twin Peaks Line meets San Francisco Downtown at Castro Street Station in the vicinity of the east portal of Twin Peaks Tunnel.

West of this station the subway line follows Market Street to about Eureka Street where the existing Twin Peaks streetcar tunnel begins. The two rapid-transit tracks occupy separate tunnels under Twin Peaks. The northern track outbound for Daly City, utilizes the existing Twin Peaks Tunnel modified for single-track rapid-transit operation. A parallel inbound track occupies a new tunnel.

The existing Forest Hill Station will be modified to serve both tunnels. The west portal of the existing tunnel must be rebuilt to permit the tunnels to merge into a two-track subway in West Portal Avenue. The West Portal Station is planned at Ulloa Street.

At St. Francis Circle sufficient depth is maintained to permit the proposed Western Freeway to pass above the transit line and beneath Sloat Boulevard. West and south of the St. Francis Circle Station, the subway follows the Muni "M" Line to Nineteenth Avenue with its wide center mall. Subway stations are proposed at Stonestown and Park Merced.

Proceeding south under Nineteenth Avenue the subway again goes deep to pass beneath the depressed Western Freeway, which is planned to follow Junipero Serra Boulevard.

South of Junipero Serra Boulevard the transit line proceeds under private right of way between St. Charles Avenue and Chester Avenue. It crosses the deep Stanley Drive or Brotherhood Way on a bridge structure, again enters subway, and crosses under Alemany Boulevard, proceeding into San Mateo County.

In Daly City, the rapid transit subway passes deep beneath the proposed interchange roadways and ramps where the Southern Freeway will meet the Junipero Serra Freeway. The Daly City subway station is proposed beneath Knowles Avenue along the route of the San Bruno Branch Line of the Southern Pacific Railroad. This terminates the Twin Peaks Line. South of the station the transit line rises to grade, and storage tracks are provided between North Parkview and Westlake Avenues and between Westlake Avenue and School Street.

The general route of the Twin Peaks Line was largely determined by the City and County of San Francisco. Within the general confines of the corridor set by San Francisco, minor alternative routings were studied as a regular procedure of detailing the line.

The problem of constructing two tracks of rapid transit through Twin Peaks was studied, predicated upon San Francisco's position that the

equipment on the Twin Peaks rapid transit line be of the same size and performance as that proposed for all other District lines. The existing Twin Peaks Tunnel, presently used by streetcars of the Municipal Railway, is too narrow to accommodate properly two tracks for this larger and faster rapid transit equipment.

Three alternative schemes considered were:

- (a) Enlarge the existing tunnel for two-track operation.
- (b) Modify the existing tunnel for one-track operation and bore a new parallel tunnel for the second track.
- (c) Construct a new tunnel for two-track operation.

As a result of comparative studies, including the consideration of rebuilding the existing cut-and-cover approach sections and the existing Forest Hill Station, alternative (b) was selected.

As stated under San Francisco Downtown, a major alternative for the Twin Peaks Line is a rapid transit line using streetcars. This plan would utilize and improve the present streetcar system maintaining its advantages of collection and delivery west of Twin Peaks, and it would avoid the costly tunnel construction and reconstruction. From some point on Market Street, the streetcars would run underground in subway through the whole congested section of Market Street.

3a Marin Line - San Francisco County --The Marin Line links San Francisco with Marin County. It originates at Post and Market Streets at the Kearny Street Station where passenger transfer to and from the Montgomery Street Station is provided. For estimate purposes, the Marin Line leaves the San Francisco Downtown section at about Laguna Street. In this May 2 estimate, the line in San Francisco is entirely in subway and tunnel with mezzanines proposed at all subway stations. Stations are located at Fillmore Street, Masonic Avenue, and Eleventh Avenue near Park-Presidio Boulevard.

In San Francisco the line follows Post Street west almost to Masonic Avenue. There it crosses under the intervening block to Geary Boulevard, where it continues until it turns northward underground through the Presidio, generally paralleling Park Presidio Boulevard. Near the Marina approach road, U. S. Route 101, it turns northwesterly toward the Golden Gate Bridge.

The tracks approach the bridge from the southwest, requiring a transition structure supported on piers until framing into the existing bridge structure is feasible. Crossing the Golden Gate below the bridge deck, the line emerges and heads northeasterly toward Sausalito.

Earlier studies contemplated a route following Kearny Street, Columbus Avenue, and Lombard Street, and approaching the Golden Gate Bridge from the east. This assumed completion of the state freeway system in this area linking the bridge and downtown San Francisco, probably via the Embarcadero Freeway. This has not occurred, nor does it seem likely in the near future. The use of Lombard Street as a major surface automobile artery will continue to increase. An aerial line would probably require loss of two of the existing surface traffic lanes. Other factors militate against this route; such as preference of the Army for other routes, better service offered by the Post-Geary route, selection of the lower Market Street direct approach to the Tube, and the preference of the City for the Post-Geary route.

Other routes were studied including Ellis Street, O'Farrell Street, Geary Street and Sutter Street. As described under San Francisco Downtown, the Post Street-Geary Boulevard route was selected for reasons of better service, less conflict with the Western Addition Redevelopment Area, and better integration with the transit lines in Market Street. Also, wide Geary Boulevard is much more suitable for alternative aerial construction than other streets.

Still under consideration is a western, coastal Bridge approach through the Presidio. The City has expressed some opposition to this, hoping that this coastal area can be reserved for ultimate park and parkway purposes.

3b Marin Line - Marin County -- Upon leaving the Golden Gate Bridge, the rapid transit line passes through a short tunnel beneath Vista Point, then crosses Fort Baker mostly on structure. The line enters a second tunnel through the Sausalito hills, passes beneath Bridgeway, and emerges on the right of way of the Northwestern Pacific Railroad at Easterby Street. As the line continues along the railroad right of way, it becomes elevated. The Sausalito Station is located north of Nevada Street.

The line continues on structure to the vicinity of the Marin City highway interchange where it returns to surface and proceeds at surface along the railroad right of way to the Mill Valley Station, located immediately south of East Blithedale Avenue. The route leaves the railroad right of way a short distance north of the Mill Valley Station and turns in a northeasterly direction through a tunnel beneath the Corte Madera hills.

Crossing over Highway 101 and Paradise Drive, it returns to the surface and parallels the Northwestern Pacific Railroad right of way. The Corte

Madera Station is located near the Highway 101 - Tamalpais Drive interchange. After crossing Corte Madera Creek and Sir Francis Drake Boulevard East, the line proceeds on embankment to enter a tunnel parallel to the existing railroad tunnel. The line continues parallel to the railroad alignment and passes under Highway 101 at the California Park Overhead where it becomes elevated. The station in San Rafael is located between the railroad and DuBois Street, south of Irwin Street.

From the San Rafael Station, the line continues on elevated structure to north of Pacheco Street where it comes to surface and is aligned between the highway and the railroad. From the north end of San Rafael the line passes through another tunnel to the Los Ranchitos area. The route continues through this area generally following the railroad alignment to the Santa Venetia Station located just east of Highway 101.

Proceeding northward, the rapid transit line remains at surface on the west side of the railroad to the north boundary of Hamilton Air Force Base, where it becomes elevated to cross both the railroad mainline tracks and a future spur line into the Base. After crossing the spur line, the route descends to surface and terminates at a surface station and storage yard at Ignacio.

An alternative route was investigated from Richardson Bay to the station at Corte Madera. It paralleled Highway 101 to the east with an elevated station located adjacent to the Alto interchange. Preliminary cost estimates indicated excessive construction costs because of the extensive elevated structure required. Furthermore, the station location did not serve the area adequately and the cost of right of way would be much greater through the commercial-zoned property adjacent to the highway.

Early studies were made of alternative routes through the Corte Madera-Larkspur area. The original route parallel to the Northwestern Pacific Railroad was not acceptable to either of the communities involved. Routes were investigated that tunneled through the Corte Madera hills to a north portal located in the quarry that lies west of Highway 101 and south of Tamalpais Drive. From the tunnel portal, one alternative passed to the west of the Corte Madera Shopping Center on elevated structure and then descended to the surface. A station was located west of the highway and the route passed beneath the highway at the existing railroad overpass. A second alternative crossed over Highway 101 adjacent to the Corte Madera interchange, and the station was located east of the highway. Neither of the alternatives served the area as well as the selected route.

Construction costs were greater due to extensive elevated construction, and each alternative was more disruptive and less acceptable to the community.

Numerous alternative routes were studied through the Santa Venetia area. Two of these tunneled beneath the highway and crossed the site of the future Marin County Government Center, and three others remained on the west side to cross the highway at the existing Forbes Overhead.

The routes crossing the County Civic Center were not found feasible due to excessive lengths of tunnel and elevated structure and due to the type of development planned for the area.

Of the three routes on the west side of Highway 101, two were parallel to the railroad alignment and the third was adjacent to the highway. The most economical route, maintaining rapid transit minimum standards, is one that generally follows the railroad alignment through the Los Ranchitos area. Further consideration is being given to the route that parallels the highway in the Los Ranchitos area, particularly in view of a more recent Air Force recommendation that the line now be placed to the east of the railroad through Hamilton Air Force Base. By eliminating the railroad crossing, the cost of the transit alignment for this alternative will more nearly equal the cost of the route estimated, and the alignment may also prove more acceptable to the community.

The major alternative route investigated for the Marin Line north of the Santa Venetia Station is parallel to Highway 101. The highway has numerous grades that exceed those established for rapid transit. The cost of tunnelling to improve the grade is prohibitive compared to surface operation adjacent to the Northwestern Pacific Railroad.

4. Peninsula Line -- The Peninsula Line leaves the San Francisco Market Street complex in subway under Ninth Street to Division Street where it generally follows the alignment of the Western Pacific Railroad. Near Potrero Hill the line turns eastward, leaving the Western Pacific Railroad. It then enters a new tunnel beneath Potrero Hill. For estimating purposes, the Peninsula line begins at the point where the line enters the Potrero Tunnel.

South of Potrero Hill, the transit line emerges from the tunnel on the same grade and on the west side of the Southern Pacific Railroad and generally parallels the mainline tracks. The first station is located at Army Street.

South of Army Street the transit line passes through a new two-track tunnel, paralleling the existing Southern Pacific Tunnel No. 3. The rapid transit line then rises on structure and crosses over the Southern Pacific main-line tracks, returning to grade along the east side of the railroad just north of existing Tunnel No. 4. It is proposed to acquire rights to existing Tunnel No. 4 and construct a new parallel tunnel for the Southern Pacific Railroad. The Candlestick Station is located on surface just south of Tunnel No. 4.

South of Brisbane, near Sierra Point, the transit line departs from the Southern Pacific Railroad route, crosses over to the west of the railroad and enters a new tunnel beneath the old Bayshore Highway. Approaching South San Francisco on the west side of Airport Boulevard, the line swings into the center of Airport Boulevard on aerial structure. The South San Francisco Station is just north of East Grand Avenue.

To the south, the transit line again follows the west side of the Southern Pacific route on aerial structure to San Bruno. There the transit line joins the right of way of the old Market Street Railway. The San Bruno Station is located just south of San Mateo Avenue. The next two stations are the Millbrae Station at Center Street and the Burlingame Station between Oak Grove and Burlingame Avenues.

South of Burlingame Avenue, the transit line on aerial structure leaves the old Market Street Railway route and joins the right of way of the Southern Pacific Railroad. The San Mateo Station is planned at 5th. Avenue, and the Hillsdale Station is planned at 25th. Avenue. The next two stations are Carlmont, located north of Holly Street, and Redwood City, located at Jefferson Avenue. The Menlo-Atherton station is located just north of Ravenswood Avenue.

Aerial construction continues into Santa Clara County. The Palo Alto Station is located just north of University Avenue. To the south is a second Palo Alto station located at California Avenue. The aerial transit line crosses the Los Altos Branch of the Southern Pacific Railroad and descends to grade. Surface construction continues to the end of the line in Mountain View, where a terminal station, San Antonio Avenue, and a yard are proposed.

The general alignment of this route has received a large measure of approval from the planners and engineers of the County of San Mateo and the Peninsula cities. An alignment further to the east moves the transit line away from the center of population, increasing the travel distance and inconveniencing the patrons. A shift westward toward El Camino Real places the line in densely built-up commercial and

residential areas. This is unacceptable and would involve prohibitive cost. The route along the Southern Pacific Railroad uses an accepted commuter corridor occupied generally with development compatible with a rail transit line.

In the study of location for this line certain alternative routings were compared on various bases, such as economy, service, operating considerations, and acceptability.

A line was considered leaving San Francisco Downtown via Ninth Street, Division Street, and private right of way to Seventh Street, to the Southern Pacific Railroad main line tracks. This results in added length and inferior profile.

A terminal station and yard site along the Los Altos Branch of the Southern Pacific Railroad was considered. Such a yard, however, is on the valuable and highly-priced land of the Stanford Industrial Park.

Under present study and estimate is a route leaving San Francisco Downtown through the Mission District. This line passes through Daly City, Colma, and South San Francisco, and is an alternative Peninsula Line north of San Bruno. Within the Mission District the line has two alternative routings. One occupies part of the proposed Southern Freeway corridor from Bernal Cut to Daly City, and the other lies in Alemany Boulevard.

Between South San Francisco and Menlo Park, an alternative plan for the transit line is under estimate. This line is generally surface construction at the same elevation as the Southern Pacific Railroad tracks. This arrangement requires that all existing grade crossings of the Southern Pacific Railroad be eliminated.

The more important crossings would be replaced by grade-separation structures permitting the streets to cross over or under the railroad and transit line.

5. Trans-Bay Tube -- The Trans-Bay Tube is the vital link connecting the rapid transit system east and west of San Francisco Bay. The alignment has been determined by the two approaches and by physical controls in the Bay, primarily the piers of the San Francisco-Oakland Bay Bridge. The San Francisco approach is a prolongation of the alignment of the Market Street Subway. The Subaqueous Tube curves slightly, passes between Piers 4 and 5 of the Bay Bridge, and completes its water crossing at the Southern Pacific Mole in Oakland. Coming to surface via cut-and-cover transition construction, the line connects with the proposed

rapid transit main yards and shops, and passes beneath the Maritime Street Overpass. To the east, it rises on structure and proceeds in Seventh Street, which is planned to be widened by Oakland, to the West Oakland Station.

The cost estimate has been divided into three major segments -- the Subaqueous Tube and its two approaches. The San Francisco Approach is that section between Montgomery Street Station and the ventilation building. The Subaqueous Tube includes the ventilation building on each side and the crossing itself. The Oakland Approach is that portion between the Oakland ventilation building and the West Oakland Station.

Alternative alignments have been studied, particularly on the San Francisco side. The principal alternative, a Washington Street approach, was determined to be more costly and to have objectionable factors of alignment and operation.

Details of the tube design, determination of line and profile, and description of the program of analysis of bay subsurface conditions and of earthquake effects are covered in a report devoted entirely to the Trans-Bay Tube.

Separate financing for the Trans-Bay Tube is provided by Senate Bill 519. The cost estimates for the tube and its approaches, however, are included in these working estimates.

6. Oakland Downtown -- Serving the downtown area of Oakland is a three-pronged rapid transit junction located in Broadway. Lines radiate to San Francisco and the West Bay via the Trans-Bay Tube; to Southern Alameda County via Eighth Street; and to the Berkeley-Richmond area and to central Contra Costa County via the Grove-Shafter Freeway.

From Broadway the line to the Tube passes in subway beneath Nimitz Freeway and swings westward along Fifth Street in private right of way, where it becomes elevated. The West Oakland Station is planned between Fifth and Seventh Streets and between Center and Peralta Streets. West of the station the line becomes the Oakland Approach to the Trans-Bay Tube.

In Broadway are the two primary delivery stations of Oakland Downtown -- one between Nineteenth and Twentieth Streets and one at Eleventh Street. The line in Broadway consists of three tracks on two levels -- trains bound to Richmond and Concord are on the upper track and those to San Francisco and Union City are on the lower track. On the third track, which is on the upper level, during peak hours and moving in the peak direction, are express trains between San Francisco and Richmond.

Just south of the Eleventh Street Station is an underground interchange permitting all connections between the Broadway complex and the Trans-Bay Tube and the Southern Alameda County line.

From the three-way junction, the line to Southern Alameda County turns southeasterly in subway in Eighth Street. A station is proposed at Fallon Street, and south of this station, the rapid transit line becomes elevated and is termed the Southern Alameda County Line.

The routes to Richmond and Concord leave Broadway in subway under private right of way, pass beneath Telegraph Avenue, and enter the median of the proposed Grove-Shafter Freeway near West Grand Avenue. The northern limit of Oakland Downtown is the subway portal north of West Grand Avenue.

The transit line with two primary delivery stations was examined in Franklin Street, in Broadway, and in a combination of Broadway and Telegraph Avenue. Delivery and service on the Broadway Telegraph Avenue route are not as good as on a full Broadway route. A Franklin Street location more nearly bisects the future central business district, the center of which seems to be shifting toward the Lake. Disruption of traffic flow and to business establishments is less. Construction costs and utility costs, however, are somewhat higher in Franklin Street although right-of-way costs are less. The choice of Broadway was based on the considered desires of the business and professional community.

The Southern Alameda County Line was studied in a Ninth Street location. This route, however, bisects Civic Center property where more buildings and possibly a stadium are planned. It prohibits a Broadway station south of Eleventh Street, thus forcing the two primary stations very close together.

Eighth Street, Seventh Street and Fourth Street were studied as alternative locations of the line to the Trans-Bay Tube. The location of the Nimitz Freeway traffic corridor and the redevelopment areas defined in the West Oakland General Neighborhood Renewal Plan, make the selected route the most economical and acceptable.

Several alternative track arrangements for Oakland Downtown were studied, including systems of two tracks, three tracks and four tracks, all in subway. Some afford less capacity and result in a bottleneck on both the Berkeley-Richmond Line and the Central Contra Costa Line. Others give as much capacity and flexibility as the adopted arrangement, but are more costly.

7. Berkeley-Richmond Line -- Rising from the Oakland Downtown subway at Jefferson Street and West Grand Avenue, the three-track system enters the median of the proposed elevated Grove-Shafter Freeway. The three tracks continue on embankment and on structure at the same grade as the freeway. The line crosses under the proposed MacArthur Freeway to a two-level MacArthur Station at 40th Street with selective loading for Oakland and San Francisco-bound trains. Two tracks, comprising the Central Contra Costa Line, continue in the freeway median. The two tracks of the Berkeley-Richmond Line cross over the southbound freeway lanes and proceed north on aerial structure in Grove Street.

The line proceeds along Grove Street to Adeline Street, and thence along Adeline Street to the Grove Street Station located south of Ashby Avenue. A transition to subway under Shattuck Avenue is accomplished south of Dwight Way in Berkeley. The line remains in subway under Shattuck Avenue into the Berkeley Station at Addison Street. The subway alignment turns west along Hearst Avenue and emerges to cross over Grove Street where aerial construction resumes.

A station is planned at Sacramento Street in Berkeley. The line turns north and proceeds through Albany along the west side of the Atchison Topeka & Santa Fe Railway right of way. Continuing along the west side of the Santa Fe tracks, the line proceeds through El Cerrito with stations at Fairmont Avenue and Cutting Boulevard.

Crossing over San Pablo Avenue and under U. S. Route 40 Freeway, the rapid transit line heads west through Richmond on embankment along the south side of the Santa Fe tracks. It crosses over 37th Street, Carlson Boulevard, and the Southern Pacific tracks on structure. At 13th Street it returns to aerial structure and turns north to cross the Santa Fe tracks to a station at MacDonald Avenue between 5th and 6th Streets. A terminal yard is proposed along the south side of Pennsylvania Avenue between 4th and 6th Streets.

North of Oakland, there are many alternative routes. These include Broadway, College Avenue, Telegraph Avenue and San Pablo Avenue. From the standpoint of minimum cost and community disruption, it is desirable to combine the southernmost legs of the lines to Richmond and to Concord into a single route. There are two possible routes that are oriented to accomplish this objective -- Telegraph Avenue and the Grove-Shafter Freeway. Since the combined operation of the two lines requires a three- or four-track system, it is deemed undesirable to construct a structure of this width along Telegraph Avenue. Agreement has

been reached with the State Division of Highways for joint use of the proposed Grove-Shafter Freeway.

Shattuck Avenue was considered as an alternative to Grove Street. Although the use of Shattuck Avenue from the freeway to Ward Street offers a more direct alignment, other considerations favor the more westerly line on Grove Street. It was apparent that along either line the existing street right of way needs to be widened by clearing development from one side. At the same time this widening would make possible the improvement of the local street to the level of a major divided arterial. The right-of-way widening on Grove Street is several blocks less than that on the Shattuck Avenue alternative. Moreover, community planning and traffic engineering staffs agree that since transit construction provides a greatly improved local vehicular artery in either case, it should be in Grove Street rather than Shattuck Avenue.

In view of the directive of the Berkeley Master Plan, the insistence of downtown merchants, and the intensity of commercial activity in Central Berkeley, it is essential to plan subway at least between Dwight Way and University Avenue. Even though study of an aerial line in this area is scheduled for further study, such an alternative appears unacceptable to Berkeley.

The provision of subway in this area necessitated re-opening the question of which street to follow in leaving Central Berkeley. Either Berkeley Way or Hearst Avenue offers better gradients and operating characteristics than does the principal alternative route, Cedar Street. More importantly, the Hearst Avenue alignment shortens the length of subway. Study is now being devoted to shortening the subway still further by moving the line to Berkeley Way.

An alternative subway plan was suggested by the campus planning staff of the University of California. This route utilizes Telegraph Avenue with a subway station at Bancroft Way, a tunnel under the campus to a subway station in University Avenue at Shattuck Avenue and an elevated structure along University Avenue. The route is somewhat longer and more expensive than the route selected for this estimate and it is believed that the additional length of route and additional cost cannot be justified on the basis of the small patronage differential.

Several alternative routes from Central Berkeley to Richmond were investigated to various degrees. These principally included various types of construction along San Pablo Avenue and along the Santa Fe Railway right of way. At the request of the communities concerned, other routes were investigated, including subways along San Pablo Avenue, the Santa Fe

Railway right of way and along Shattuck Avenue and Colusa Avenue. None of these routes appear feasible from the standpoint of cost. A suggested route along the waterfront was also studied, but such a route is not a desirable route for optimum transit service.

Several station sites were studied for the Richmond area, and the following locations were evaluated in a special report dated March 10, 1960:

Site A, 14th and Barrett Streets; Site B, 10th and Ohio Streets; Site C, 2nd Street and MacDonald Avenue; Site D, The Atchison Topeka & Santa Fe Railroad Station; Site E, Eastshore Freeway at San Pablo Dam Road; Site F, 6th Street and MacDonald Avenue. Site F was selected for this estimate.

8. Southern Alameda County Line -- From the Fallon Street Station of the Oakland subway system, this line ascends to an aerial structure in the center of East 8th Street. The rapid transit line follows East 8th Street for a few blocks, leaving it to parallel the Western Pacific Railroad. Proceeding along the east side of these tracks, the line passes under the 19th Avenue grade separation structure. From this point, the transit line departs from the railroad, ascending to elevated structure in the center of East 12th Street. At Fruitvale Avenue, the transit line departs from East 12th Street and enters the Fruitvale Station.

Leaving the station, the rapid transit line parallels the Western Pacific Railroad on one side or the other to Union City. From the Fruitvale Station to 47th Avenue, the rapid transit structure is on the east side of the railroad tracks; and from 50th Avenue southward to 105th Avenue, it is on the west side. The 77th Avenue Station is located midway between 77th and 81st Avenues.

South of 105th Avenue, the transit line follows the east side of the railroad. The San Leandro Station is located at Davis Street; the Hesperian Station is south of Hesperian Boulevard in San Leandro; and the Hayward Station is north of Jackson Street.

Immediately south of the Hayward Station, the aerial rapid transit line crosses to the west of the railroad. Near Tennyson Road, the line construction changes to embankment, except where structures are required for vehicular and rail cross-traffic. An elevated station is located at Alquire Road. For the few blocks through the former town of Decoto, now Union City, an elevated structure is used, terminating at the Union City Station at Decoto Road. A terminal yard is immediately south of Decoto Road.

The principal alternative to the route estimated is one paralleling the Southern Pacific Railroad tracks from 33rd Avenue in Oakland to Decoto Road in Union City. In general, this route is further removed from the centers of population than is the line following the Western Pacific. Conflicts with rail cross-traffic are more numerous along the Southern Pacific. Construction and right of way costs along the Southern Pacific are comparable to those along the Western Pacific except for a serious problem area at "A" Street in Hayward. Here, the conflicts with the multitrack operation of the railroad and dense industrial growth on each side force the rapid transit line underground. In addition, the Southern Pacific alignment is relatively inaccessible over existing local traffic arteries.

There are areas along such arteries as East 14th Street, Foothill Boulevard and the Nimitz Freeway where elevated transit construction is quite feasible. Along each of these routes, however, there are substantial right-of-way and construction problems in areas like the Hayward business district on Foothill Boulevard and the San Leandro section of East 14th Street.

The Nimitz Freeway alignment is even more remote from the population centers than is the Southern Pacific Railroad. The Freeway median is too narrow for transit construction. Parallel transit construction is not feasible due to extensive subdivision developments immediately adjacent to the freeway.

Numerous alternatives were considered in connection with the Western Pacific Railroad alignment. These include surface construction south of 143rd Avenue, and the use of the opposite side of the railroad.

If means can be found to finance the more costly grade separations for both transit and the Western Pacific Railroad, surface construction of the rapid transit line could be feasible.

An extension from Decoto Road to Fremont is being studied and estimated. Under this plan the terminal station would be at Mowry Road.

9. Central Contra Costa Line -- Beginning in downtown Oakland, the rapid transit tracks to Concord and to Richmond jointly occupy the median of the proposed Grove-Shafter Freeway and are estimated as a part of the Berkeley-Richmond Line. Near 45th Street the two lines separate. The Berkeley-Richmond Line continues to the north while the Central Contra Costa Line stays in the median of the elevated freeway to the College Avenue Station immediately east of College Avenue. The line continues at freeway

grade in the median, through the interchange with the Warren Freeway, and approaches the Berkeley Hills tunnel. The rapid transit tracks cross under the west-bound freeway lanes and enter twin tunnels north of the proposed highway tunnels.

Emerging at Orinda, the line becomes elevated on structure to pass through the Orinda Station in the northwest quadrant of the Orinda interchange. Crossing over the ramps of the interchange, the line remains parallel to the freeway in graded section as far as the Acalanes Boulevard Interchange except for a short tunnel under the crest of the hill at Charles Hill Road. The line proceeds on structure over the ramps of the Acalanes Boulevard interchange, Upper Happy Valley Road, and Sunnybrook Drive. It then passes under the Mt. Diablo Boulevard grade-separation structure west of Lafayette and continues on structure and graded section along the south edge of the freeway to the Lafayette Station at Oak Hill Road.

The line continues generally at surface, becoming elevated west of the Pleasant Hill Road Interchange. After crossing the east-bound freeway lanes, the line proceeds on structure in the median of the freeway until it makes a transition to the tunnel under El Curtola Boulevard. The line emerges from the tunnel on the south side of the freeway. It parallels the freeway on graded section, becoming elevated on structure to cross over Boulevard Way and Dewing Lane. After passing under the freeway just north of the Majon Way grade-separation structure, the line enters the elevated Walnut Creek Station located west of California Avenue.

From the Walnut Creek Station the line remains elevated on structure, occupying the existing Sacramento Northern Railway right of way until it crosses Kazebeer Road. Except for elevated structure at the Pleasant Hill Station, the line runs at surface in the existing railway right of way to Oak Grove Road. The Pleasant Hill Station and a yard occupy the triangle formed by Geary Road, the Sacramento Northern right of way and the Southern Pacific right of way. After passing under Oak Grove Road, the line closely parallels the Sacramento Northern Railway on aerial structure from San Miguel Road to the Concord Station at Clayton Road.

Previous studies provided for entirely separate routes through Oakland for the line to Richmond and the line to Concord. North of West Grand Avenue, the line continued underground in Broadway making a transition to elevated at 30th Street. Proceeding elevated along Broadway, the line extended past Patton Street and entered a tunnel, which provided the connection to Central Contra Costa. Also considered were alternative routes utilizing various combinations of city streets to develop an economical route for elevated construction.

The preferred route combines the Berkeley-Richmond Line and the Central Contra Costa Line in the median of the proposed Grove-Shafter Freeway. In the event that delays in financing the transit project prevent joint construction, adequate space may not be available for four parallel rapid-transit tracks in the median of the Grove-Shafter Freeway. Such circumstances would require the complete re-evaluation of this section.

Different routes through the Berkeley Hills were studied.

The first alternative proceeds east of Lake Merritt along 14th Avenue, and in Dimond Canyon it enters a series of tunnels to Lafayette. This route has the advantage of serving densely populated areas of Oakland with stations at MacArthur Freeway and Warren Freeway. Also the Orinda Station is closer to the center of population and several important trafficways. Nearly four miles of tunnel makes the route the most expensive alternative, and it also appears to be unacceptable to the City of Oakland.

The shortest tunnel alternative requires long steep grades to the west and joint transit-highway use.

The eastern approach to the short tunnel crosses an extremely unstable slide area and presents very serious and expensive problems of construction and maintenance. Also, the construction schedule does not fit that of the freeway to the west.

The most practicable tunnel plan requires three-and-a-quarter miles of tunnel. This tunnel, extending from the Chabot School area to the Orinda Crossroads, provides the easiest profile and minimizes construction problems. This route is being estimated currently.

The two-and-a-half-mile tunnel included in this May 2, 1960 estimate is a compromise between the short and long tunnels. Because of the timing, it does not appear possible that this plan can be coordinated with the State's freeway plans.

Careful consideration was given to various combinations of routes using surface, elevated, and tunnel construction along existing and proposed freeways and expressways between Orinda and Concord. More detailed engineering investigations are required to refine the alignments adjacent to State Sign Route 24 to achieve maximum economy, particularly with respect to unstable soil conditions and utility relocations.

Between Lafayette and Walnut Creek, Contra Costa County proposes the development of an expressway following the recently abandoned

Sacramento Northern Railway right of way. This route could be the most economical if the timing of construction can be coordinated. Such an alternative is currently under study and estimate.

From Walnut Creek to Concord routes were studied paralleling the freeway, surface roads, and the Southern Pacific right of way as well as the Sacramento Northern Railway route that was selected.

### SECTION III

#### PATRONAGE, REVENUE AND OPERATING EXPENSES

### III. PATRONAGE, REVENUE AND OPERATING EXPENSE

#### PATRONAGE

An important part of the engineering studies is the determination of the number of people that can be expected to use any part of the rapid transit system. These estimates determine the need for any system at all, and to a large extent, the physical features and service that must be provided.

The patterns and volumes of past, present, and future travel within the Bay Area were ascertained. An origin and destination survey of Bay Area travel movements was conducted in 1954. Using recent traffic counts and studies, this survey was updated to current traffic levels.

#### SECTION III

### PATRONAGE, REVENUE AND OPERATING EXPENSES

The 1954 survey did not include travel movements in the East Bay or in San Francisco. These trip patterns were included, however, in the 1960 survey. Taking into account the changes in population, job distribution, and other statistical factors, these observed movements were updated to 1969 levels. The resultant patterns were checked against those found in more recent traffic surveys. The 1969 survey checked travel volumes were checked against current highway and street traffic counts that are made regularly by the state and local highway departments and the Bay Area transit agencies.

The 1946-47 travel survey data was used as source material only for intercity movements within the City of San Francisco and the East Bay. Both of these areas were highly urbanized before World War II. Changes in population and other factors have been gradual.

These data were used to estimate travel movements for the year 1970. The data were used for a study to estimate the future of the system. The data were changed to reflect population, labor force, and other factors. The data were used to estimate the future of the system. The data were used to estimate the future of the system. The data were used to estimate the future of the system.

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### III. PATRONAGE, REVENUE AND OPERATING EXPENSE

#### A. PATRONAGE

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The patterns and volumes of past, present, and future travel within the Bay Area were ascertained. An origin and destination survey of Bay Area travel movements was conducted in 1954. Using recent traffic counts and studies, this survey was updated to current traffic levels.

The 1954 survey did not cover internal movements in the East Bay or in San Francisco. These trip patterns were included, however, in the 1946-47 Bay Area Metropolitan Traffic Survey conducted by federal, state, and local highway agencies. Taking into account the changes in population, job distribution, and other statistical factors, these internal movements were updated to 1959 levels. The resultant patterns were checked against those found in more recent traffic surveys. The 1959 zone-to-zone travel volumes were checked against current highway and transit traffic counts that are made regularly by the state and local highway departments and the Bay Area transit systems.

The 1946-47 travel survey data were used as source material only for internal movements within the City of San Francisco and the East Bay. Both of these areas were highly urbanized before World War II, and changes in population and other factors have been gradual.

These procedures resulted in the base travel movements for 1959. The year 1975 was selected for a separate estimate of future travel movements. The forecasted changes in land use, population, labor force, employment, auto registration, and other factors were studied and evaluated. Basic data for these studies and trends were obtained from Mr. Van Buren Stanbery and Mr. Alan Voorhees and from other established consultants in these fields.

The trip patterns for 1959 and 1975 were analyzed to determine which movements could be of valid interest to the rapid transit system. The next and most critical step was to determine the percentage of the total volume of trips of valid interest that could be attracted to a modern regional rapid-transit system.

Percentages of traffic diversion or attraction were developed. Various travel conditions that might measurably affect diversion to rapid transit were analyzed. These include purpose and time of day of trip, whether a trip was made to a major business district, travel time and cost, degree of auto ownership, and personal income levels.

There exists but little observed or published research data as to why passenger traffic is distributed as it is between automobiles and public transit in metropolitan areas. Further, the rapid transit system proposed for the Bay Area is without parallel when compared with existing systems anywhere in the world. It will have scheduled speeds nearly twice as high, and stations are spaced further apart than on any existing rapid transit network, most of which serve only local urban trips.

The traffic corridor between the Peninsula and San Francisco, restricted as it is by the Bay and the hills, offered the best basis for a study of the distribution of travelers between automobiles and interurban transit. In this corridor, the Southern Pacific operates a rail commuter line with schedules heavily oriented to travel in the peak hours. Greyhound Lines complement that service, and the Bayshore Freeway also serves the traffic corridor.

The results of this study highlighted certain factors of principal importance in determining rapid transit utilization. These are: whether the travel occurs in the peak period, whether the objective of travel is for work or other purposes, whether travel is to or from a major business district, and the ratio of total travel time by transit over time by automobile. Using these data, curves were developed, giving the percentage of diversion to rapid transit.

For internal trips, however, that originate and terminate within the City of San Francisco or within the East Bay internal areas, a different diversion curve was developed. A curve developed in a special research study conducted in the Chicago metropolitan area was used as a guide, but it was adjusted to reflect comparable experience in the Bay Area.

The result of these analyses was an estimate of station-to-station rapid transit travel for the year 1959 and the year 1975. From these two cardinal points, traffic estimates for the years 1967 through 1980 were developed and are presented in the following tabulation:

<u>Year</u>	<u>Total Passenger Trips</u>
1967	89,453,000
8	111,261,000
9	123,151,000
1970	130,234,000
1	135,710,000
2	139,323,000
3	140,616,000
4	141,799,000
5	143,049,000
6	144,245,000
7	145,413,000
8	146,599,000
9	147,743,000
1980	148,911,000

#### B. REVENUE

Rapid transit revenue is a function of patronage and fare levels. The fares must be reasonably competitive with out-of-pocket costs of the private automobile. For the purpose of the estimate, a curve was adopted, establishing fare levels over various lengths of trips. The curve provides a minimum fare of 25 cents for any trip up to eight miles in length; and for trips over eight miles in length, the fare ranges from 3.2 cents per mile to as low as 2.25 cents per mile. An additional 10 cents has been added to the fare for trips that involve a crossing of San Francisco Bay or the Golden Gate.

Typical fares are as follows:

Redwood City to San Francisco	65¢
San Rafael to San Francisco	60¢
Hayward to Oakland	40¢
Hayward to San Francisco	65¢
Orinda to Oakland	25¢
Orinda to San Francisco	55¢
Berkeley to San Francisco	50¢
Berkeley to Oakland	25¢

With respect to revenue estimates for intra-San Francisco trips an adjustment is made to allow for the effect of the higher cost of a combined bus-rapid transit or trolley-rapid transit trip compared to the cost for a bus or trolley trip today.

In addition to fare revenue, the system will generate income from advertising and concessions in the estimated amount of one per cent of fare revenue.

In summary, the estimated revenue is as follows:

<u>Year</u>	<u>Gross Fare and Concession Revenue</u>
1967	\$ 31,079,000
8	39,031,000
9	43,502,000
1970	46,289,000
1	48,516,000
2	50,013,000
3	50,585,000
4	51,118,000
5	51,664,000
6	52,197,000
7	52,705,000
8	53,246,000
9	53,735,000
1980	54,242,000

### C. OPERATING EXPENSES

Through consultation with Mr. Donald C. Hyde, General Manager of the Cleveland Transit System, the standards of service and operation were established, a train schedule was prepared, and operating costs were estimated. To the extent applicable the experience of modern American rapid transit systems was studied as a guide in preparing the operating expense estimate for this system. However, the advanced operating concepts applied to the ultra-modern and extensive system proposed for the Bay Area necessitated a special operating expense estimate.

Trains are generally scheduled to provide service at least every five minutes in the peak hour with somewhat closer intervals at the crest of each peak. Between the peaks, at least a fifteen-minute train frequency is planned, but service during the late evening and night hours will be adjusted to meet the lighter demands of traffic.

The estimated operating expense for the system is as follows:

<u>Year</u>	<u>Total Operating Expense</u>
1967	18,316,000
8	20,943,000
9	22,067,000
1970	22,464,000
1	23,358,000
2	24,098,000
3	24,290,000
4	24,483,000
5	24,659,000
6	24,930,000
7	25,201,000
8	25,473,000
9	25,744,000
1980	25,990,000

The estimated net operating revenue is as follows:

<u>Year</u>	<u>Net Operating Revenue =</u> <u>Gross Fare and Concession Revenue</u> <u>Minus Total Operating Expense</u>
1967	12,763,000
8	18,088,000
9	21,441,000
1970	23,825,000
1	25,158,000
2	25,915,000
3	26,295,000
4	26,635,000
5	27,005,000
6	27,267,000
7	27,504,000
8	27,773,000
9	27,991,000
1980	28,252,000

#### D. ROLLING STOCK REQUIREMENTS

Estimates of cost of rolling stock of the type adopted for the yardstick system were received from prominent car manufacturers. These estimates were used as a basis for deriving a suitable car cost estimate. The estimate includes allowances for inflation.

The number of cars required to operate the entire system for each year has been estimated, including 7 per cent for spare units.

Following is a tabulation of car requirements and costs:

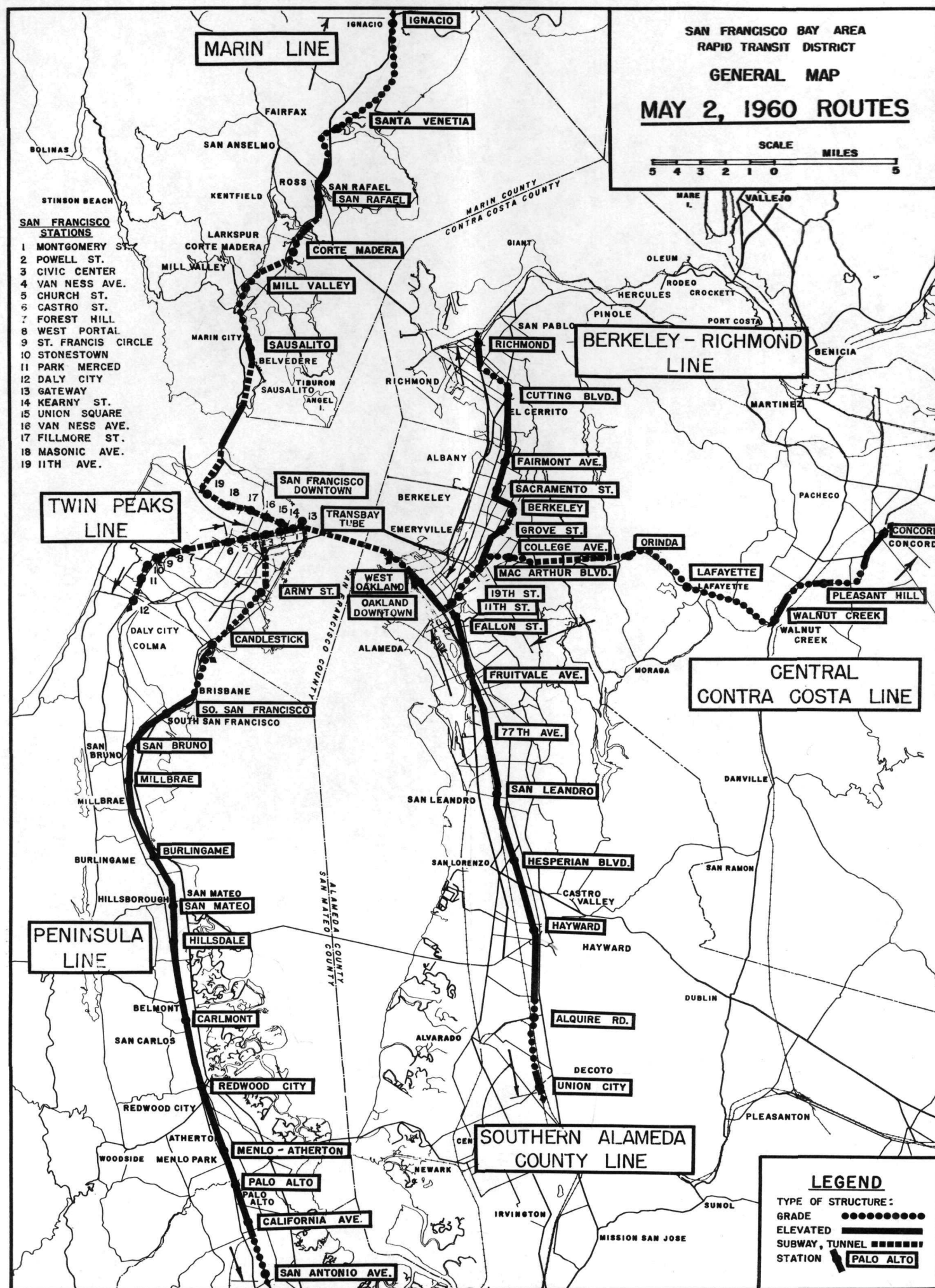
<u>Year</u>	<u>Number of Cars</u>	<u>Cost</u>
1967	630	\$ 94,500,000
1968	120	18,600,000
1969	60	9,600,000
1970	40	6,600,000
1971	40	6,600,000
1972	30	4,950,000
1973	10	1,650,000
1974	10	1,650,000
1975	10	1,650,000
1976	20	3,300,000
1977	10	1,650,000
1978	10	1,650,000
1979	10	1,650,000
1980	10	1,650,000
	<u>1010</u>	<u>\$155,700,000</u>

#### E. GENERAL ASSUMPTIONS

The estimates of traffic, revenue, operating expense,, and rolling stock are based upon certain general assumptions.

1. The same general trends of economic activity and business conditions experienced during the past five years will continue in the Bay area.
2. Adequate and attractive parking spaces are provided in close proximity to rapid transit stations. These are included in the estimates of construction cost.

3. Transit service in the Bay Area will be coordinated with regional rapid transit. The coordination should secure re-routing, where feasible, of existing interurban and local transit operations to act as feeders to the regional rapid transit system.
4. The San Francisco Bay Area Rapid Transit District will retain sole authority for establishing fares, concession rates, and fees.
5. There will be no adverse legislation affecting the use, operation, condition, or financial obligations of the San Francisco Bay Area Rapid Transit District or the rapid transit system.
6. The rates of toll charged for vehicular passage across San Francisco Bay and the Golden Gate will be no less than their present levels.
7. No charges will be levied by the California State Toll Bridge Authority or by the Golden Gate Bridge and Highway District against the rapid transit system beyond the capital cost of construction or rehabilitation and annual maintenance of the appropriate section of rapid transit right of way.
8. Highway planning for the Bay Area will be complementary to and not destructive of the functions of the rapid transit system.
9. An appropriate policy of advertising and public education will be followed by the District to encourage rapid transit patronage.



PARSONS BRINCKERHOFF - TUDOR - BECHTEL

General Engineering Consultants To  
The Francisco Bay Area Rapid Transit District  
833 Market Street

San Francisco 3, Cal.

June 6, 1960

SAN FRANCISCO

BAY AREA RAPID TRANSIT DISTRICT

Rapid Transit District  
628 Flood Building  
San Francisco, California

Dear Mr. Hoover:

The estimates presented herein reflect the completion of several of the engineering studies described in our letter of February 9 and in our report of May 2 and scheduled for completion after May 1. These include the Peninsula Line via the Mission-Alameda corridor in San Francisco, aerial construction in Geary Boulevard and rapid transit at grade on the Peninsula. **SUPPLEMENTARY ESTIMATES** in this June 6 report, which is supplementary to our May 2 report entitled "Working Estimates JUNE 6, 1960 Routes." Certain other estimates, including the possibility of rapid transit in the median strip of the Southern Freeway in San Francisco, an extension to Fremont, and others are scheduled for completion before June 30.

In accordance with your instructions we have considered the effects of postponing construction of parts of the 1960 regional rapid transit system that was described in our previous report. Likewise, we have considered various other practical possibilities there are to reduce the cost of construction and still provide comprehensive service within the five-county district. As a result, we have formulated two alternative transit systems, the choice between them involving **PARSONS BRINCKERHOFF - TUDOR - BECHTEL**

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General Engineering Consultants To  
San Francisco Bay Area Rapid Transit District

833 MARKET STREET

SAN FRANCISCO-3-CAL.

June 6, 1960

The description of these systems and the considerations leading to their formulation are set forth in the report transmitted herewith. For each system the report presents estimates of construction, patronage, revenue, operating expenses, and rolling stock. The report also includes a comparison of these alternative systems with each other and

Mr. Kenneth M. Hoover  
San Francisco Bay Area  
Rapid Transit District  
628 Flood Building  
San Francisco, California

Dear Mr. Hoover:

The estimates presented herein reflect the completion of several of the engineering studies described in our letter of February 9 and in our report of May 2 and scheduled for completion after May 1. These include the Peninsula Line via the Mission-Alemany corridor in San Francisco, aerial construction in Geary Boulevard and rapid transit at grade on the Peninsula, all of which are discussed in this June 6 report, which is supplementary to our May 2 report entitled "Working Estimates - May 2, 1960 Routes." Certain other estimates, including the possibility of rapid transit in the median strip of the Southern Freeway in San Francisco, an extension to Fremont, and others are scheduled for completion before June 30.

In accordance with your instructions we have also studied the effects of postponing construction of parts of the May 2, 1960 regional rapid transit system that was described in our previous report. Likewise, we have considered what other practical possibilities there are to reduce the cost of construction and still provide comprehensive service within the five-county district. As a result, we have formulated two alternative first-stage systems, the choice between them involving matters of policy.

The description of these systems and the considerations leading to their formulation are set forth in the report transmitted herewith. For each system the report presents estimates of construction, patronage, revenue, operating expenses, and rolling stock. The report also includes a comparison of these alternative systems with each other and with the May 2 system.

The May 2, 1960 report and this June 6, 1960 report are presented to provide the District with basic data to enable the District to weigh the advantages and disadvantages of the various systems. The Joint Venture recommendations will be made subsequently.

Very truly yours,

PARSONS BRINCKERHOFF-TUDOR-BECHTEL



W. S. Douglas

## PURPOSE OF REPORT

### TABLE OF CONTENTS

- A. Purpose of Report
- B. Possibilities to Reduce the Cost of the May 2 Rapid Transit System
- C. June 6, 1960 Routes - Peninsula Line via Bayshore
- D. June 6, 1960 Routes - Peninsula Line via Mission-Alemany
- E. Patronage, Revenue, Operating Expenses, and Rolling Stock
- F. Construction Costs
- G. Comparison of Mission-Alemany vs. Bayshore First Stage Peninsula Routes

Appendix A - Reduction of Extent of Rapid Transit Lines

Appendix B - Peninsula Line, On-Grade Construction

Appendix C - Peninsula Line via Bayshore

Appendix D - Peninsula Line via Mission-Alemany

## A. PURPOSE OF REPORT

Since the activation of the contract dated May 1, 1959 between Parsons Brinckerhoff-Tudor-Bechtel and the San Francisco Bay Area Rapid Transit District, representatives of the Joint Venture have met with the professional staffs and other representatives of the participating counties and affected municipalities in an effort to work out with them acceptable rapid transit routes and right-of-way development. Early this year a rapid transit system was formulated that most nearly met the desires of the communities. A description of that system, including estimates of patronage, revenues, operating costs, rolling stock, and construction were submitted in a report entitled "Working Estimates - May 2, 1960 Routes".

As was forecasted, the estimated cost of construction for that system is in excess of what is understood to be financially feasible under the District's present Act. For that reason, the program of estimating certain alternatives as outlined in the Joint Venture letter of February 9 was continued.

Subsequent to the District meeting of May 12, at which the May 2, 1960 report was presented, instructions were received from the District to analyze the effects of postponing the construction of parts of the May 2 system to second stage, and in addition to consider what other practical possibilities there are to reduce cost and establish a minimum system that provides a comprehensive service within the five county district.

A rapid transit system is an integrated whole of which each part affects the other. Because of this, the possibilities for reducing cost have been considered in terms of alternative comprehensive first-stage systems, rather than in terms of the effects of modifying or curtailing individual lines.

The purpose of this report is to present estimates of capital costs and of patronage, revenues, and maintenance and operating costs of the two most promising of such alternative systems. Its further purpose is to compare such alternatives in terms of cost and service.

With respect to equipment, power and propulsion, train control, fare collection and other rapid transit features, the estimates presented herein are predicated upon the "Yardstick System" described in the May 2 report.

B. POSSIBILITIES TO REDUCE THE COST OF THE MAY 2 RAPID TRANSIT SYSTEM

There are certain practical possibilities to reduce the cost of the five-county first-stage regional rapid transit system that was presented in the May 2 report. These are as follows:

- (1) Adoption of aerial construction in the center of Geary Boulevard, from a point near Spruce Street to the Presidio, instead of the subway construction included in the May 2 estimates at the request of representatives of the City of San Francisco. This reduces construction costs by about \$21,000,000. Geary Boulevard is 125 feet wide and traverses a commercial area. It is our opinion that aerial construction on Geary Boulevard is aesthetically acceptable and would not impair adjacent property values.
- (2) Curtailment of the extent of the various rapid transit lines to terminal points beyond which potential patrons will have access to the rapid transit system over reasonably uncongested roads. Irrespective of the extent of rapid transit routes, relatively few persons will live within walking distance of a rapid transit station. The majority of regional trips will be started by private automobile. Others will be started on buses. The actual length of the initial motor vehicle trip is not of great consequence if it is made over uncongested highways.

Curtailments in accordance with this principle, however, must be made, with due consideration to availability of adequate parking areas at the terminal stations, and to requirements for rapid transit yards.

The alternatives presented in this report propose terminating the first-stage rapid transit system at the following stations:

Marin Line at Santa Venetia  
Peninsula Line at Redwood City  
Berkeley-Richmond Line at Cutting Boulevard  
Southern Alameda County Line at Hayward  
Central Contra Costa Line at Pleasant Hill

Further description of these curtailments is contained in Appendix A.

With one exception, the terminations noted above may be adopted without serious consequences to the functioning of the first-stage rapid transit system. The curtailment of the Peninsula Line to Redwood City, however, is proposed only because Santa Clara County is not included in the Rapid Transit District. Service to Palo Alto and to at least one station beyond is very desirable in the first-stage program. It is urgently recommended that some means be found to finance that construction, which is estimated at \$32,000,000. Pledging of real estate taxes of the five-county District appears impractical.

Terminating the first stage of the rapid transit system at the stations noted results in a reduction of about \$113,000,000 in the estimates of construction cost presented in the May 2 report. It is recommended that where feasible, consideration be given to advance purchase of right of way for the curtailed segments.

- (3) Adoption of a plan for rapid transit at grade for the Peninsula Line alongside the Southern Pacific Railroad. This plan, for the Peninsula Line along the Bayshore route, involves the construction of 24 underpasses or overpasses to eliminate highway grade crossings of the Southern Pacific Railroad and the proposed rapid transit system. This includes three grade separations that are planned for construction by the State Division of Highways.

The plan estimated is one which utilizes two rapid transit tracks and leaves operations of the Southern Pacific Railroad on its own two tracks. San Mateo County has furnished preliminary plans and cost estimates for proposed grade-crossing eliminations in San Mateo County as far north as San Bruno. These estimates have been accepted in this report but adjusted to reflect generally the same level of contingencies and inflation adopted for the basic estimates. In addition, estimates have been made of certain grade separations

required by the plan along the Bayshore Route north of San Bruno.

Further information regarding this plan of construction is contained in Appendix B.

With respect to grade-crossing eliminations, present law and custom provide for participation of the State to the extent of about 45% and of the Railroad to the extent of approximately 10% of costs. With such arrangements, local participation is approximately 45% or less. In these estimates it has been assumed that the Rapid Transit District would pay the local share only, and the estimates are credited with 55% participation by others in the grade-separation costs. To implement the program, however, it is emphasized that the State would have to appropriate adequate funds for its share.

D. JUNE 6, 1960 Assuming this participation, it is estimated that such a plan and program for on-grade construction would reduce the District's costs of construction by about \$32,000,000.

Taking into account only the modifications to the May 2 system described up to this point, a necessary adjustment of an additional \$5,000,000 in the estimates for the Berkeley tunnel, the May 2 estimates are reduced by about \$161,000,000. The resulting estimated cost of the system so modified, excluding the Trans-Bay Tube and its approaches, is, in round numbers, \$1,039,000,000.

- (4) Postponement of the Twin Peaks Rapid Transit Line to second stage. To preclude opening Market Street for subway construction at two different times, first-stage construction must nevertheless include that part of the Twin Peaks Line which has a common route in Market Street with the Peninsula-Trans-Bay Line. Advance construction of this part of the Twin Peaks Line would provide an underground route for the City's trolleys from a point west of Van Ness Avenue, through the congested area, to a point between First and Second Streets, where they again return to the surface, turning around at their present terminal. This underground

route for the trolleys would substantially expedite their movements and reduce travel time.

The postponement of construction of the Twin Peaks Rapid Transit Line, except for that part described above, reduces the estimates of construction cost by approximately \$146,000,000, which is reflected in the construction cost summaries presented for the June 6 Routes.

C. JUNE 6, 1960 ROUTES - PENINSULA LINE VIA BAYSHORE

One comprehensive rapid transit system, for which estimates are presented herein, is the May 2 system with all the modifications described up to this point. This system is designated "June 6, 1960 Routes - Peninsula Line via Bayshore" and is delineated on the map bearing that title.

Route description is given in Appendix C.

D. JUNE 6, 1960 ROUTES - PENINSULA LINE VIA MISSION-ALEMANY

One major Peninsula Line alternative is the construction of a first-stage rapid transit line from Market Street through the Mission-Alemany corridor to Daly City and then south to San Bruno, beyond which the alignment of the Peninsula route remains the same as described in the May 2 report. The adoption of this alternative involves postponing to second stage the construction of the Bayshore route from Market Street to San Bruno.

A plan including this alternative as well as the other modifications to the May 2 system previously described is designated in this report as "June 6, 1960 Routes - Peninsula Line via Mission-Alemany" and delineated on the map bearing that title. Estimates of that system are presented in later sections of this report.

Description of the route and structure of the rapid transit line through the Mission-Alemany corridor is included in Appendix D.

E. PATRONAGE, REVENUE, OPERATING EXPENSES, AND  
ROLLING STOCK

The basic procedures for estimating rapid transit patronage, revenues, expenses, and rolling stock are described in the report submitting May 2 estimates. The same data, methods, procedures, and assumptions underlie the estimates herein. For convenient reference, the estimates for the May 2, 1960 Routes are included.

<u>TOTAL PASSENGER TRIPS</u>			
<u>Year</u>	<u>May 2 Routes</u>	<u>June 6 Routes</u>	
		<u>Via</u> <u>Bayshore</u>	<u>Via</u> <u>Mission-Alemany</u>
1967	89,453,000	68,052,000	75,296,000
8	111,261,000	85,914,000	94,557,000
9	123,151,000	95,788,000	105,071,000
1970	130,234,000	101,789,000	111,412,000
1	135,710,000	106,564,000	116,319,000
2	139,323,000	109,561,000	119,485,000
3	140,616,000	110,665,000	120,613,000
4	141,799,000	111,679,000	121,737,000
5	143,049,000	112,770,000	122,851,000
6	144,245,000	113,815,000	123,903,000
7	145,413,000	114,799,000	124,947,000
8	146,599,000	115,815,000	125,978,000
9	147,743,000	116,777,000	127,013,000
1980	148,911,000	117,803,000	128,040,000

The above tabulation of patronage and the following tabulations of revenue, operating expenses, and rolling stock requirements do not include any data relative to the Twin Peaks trolley system. The data refer exclusively to the regional rapid transit system and its operation.

# GROSS FARE AND CONCESSION REVENUE

<u>Year</u>	<u>May 2 Routes</u>	<u>June 6 Routes</u>	
		<u>Via Bayshore</u>	<u>Via Mission-Alemanay</u>
1967	\$31,079,000	\$25,118,000	\$26,654,000
8	39,031,000	31,819,000	33,659,000
9	43,508,000	35,441,000	37,602,000
1970	46,289,000	38,006,000	40,060,000
1	48,516,000	39,902,000	42,063,000
2	50,013,000	41,220,000	43,357,000
3	50,585,000	41,712,000	43,848,000
4	51,118,000	42,172,000	44,319,000
5	51,664,000	42,647,000	44,803,000
6	52,197,000	43,088,000	45,252,000
7	52,705,000	43,547,000	45,717,000
8	53,246,000	44,000,000	46,175,000
9	53,735,000	44,440,000	46,623,000
1980	54,242,000	44,878,000	47,074,000

# TOTAL OPERATING EXPENSE

<u>Year</u>	<u>May 2 Routes</u>	<u>June 6 Routes</u>	
		<u>Via Bayshore</u>	<u>Via Mission-Alemanay</u>
1967	\$18,316,000	\$15,901,000	\$16,516,000
8	20,943,000	18,330,000	19,049,000
9	22,067,000	19,389,000	20,168,000
1970	22,464,000	19,768,000	20,547,000
1	23,358,000	20,569,000	21,386,000
2	24,098,000	21,104,000	21,920,000
3	24,290,000	21,311,000	22,135,000
4	24,483,000	21,512,000	22,328,000
5	24,659,000	21,704,000	22,543,000
6	24,930,000	21,905,000	22,736,000
7	25,201,000	22,098,000	22,937,000
8	25,473,000	22,290,000	23,129,000
9	25,744,000	22,469,000	23,330,000
1980	25,990,000	22,669,000	23,522,000

# NET OPERATING REVENUE

Net Operating Revenue = Gross Fare and Concession  
Revenue Minus Total  
Operating Expense

<u>Year</u>	<u>May 2 Routes</u>	<u>June 6 Routes</u>	
		<u>Via</u> <u>Bayshore</u>	<u>Via</u> <u>Mission-Alemany</u>
1967	\$12,763,000	\$ 9,217,000	\$10,138,000
8	18,088,000	13,489,000	14,610,000
9	21,441,000	16,052,000	17,434,000
1970	23,825,000	18,238,000	19,513,000
1	25,158,000	19,333,000	20,677,000
2	25,915,000	20,116,000	21,437,000
3	26,295,000	20,401,000	21,713,000
4	26,635,000	20,660,000	21,991,000
5	27,005,000	20,943,000	22,260,000
6	27,267,000	21,183,000	22,516,000
7	27,504,000	21,449,000	22,780,000
8	27,773,000	21,710,000	23,046,000
9	27,991,000	21,971,000	23,293,000
1980	28,252,000	22,209,000	23,552,000

## F. CONSTRUCTION COSTS

Construction cost estimates have been prepared in the same manner as described in the May 2 report, taking into account the same factors, including inflation. Construction cost estimates summarized for the alternative June 6 systems are presented herewith. For convenient reference, the summary for the May 2 Routes is also included.

## G. COMPARISON OF ROLLING STOCK REQUIREMENTS - BAYSHORE FIRST-STAGE PENINSULA ROUTES

Year	May 2 Routes		June 6 Routes			
	Cars	Cost	Via Bayshore		Via Mission-Alemany	
			Cars	Cost	Cars	Cost
1967	630	\$94,500,000	510	\$76,500,000	540	\$81,000,000
8	120	18,600,000	110	17,050,000	110	17,050,000
9	60	9,600,000	50	8,000,000	60	9,600,000
1970	40	6,600,000	40	6,600,000	30	4,950,000
1	40	6,600,000	30	4,950,000	40	6,600,000
2	30	4,950,000	30	4,950,000	30	4,950,000
3	10	1,650,000	10	1,650,000	10	1,650,000
4	10	1,650,000	10	1,650,000	10	1,650,000
5	10	1,650,000	10	1,650,000	10	1,650,000
6	20	3,300,000	10	1,650,000	10	1,650,000
7	10	1,650,000	10	1,650,000	0	0
8	10	1,650,000	0	0	10	1,650,000
9	10	1,650,000	10	1,650,000	10	1,650,000
1980	10	1,650,000	10	1,650,000	10	1,650,000
	<u>1010</u>	<u>\$155,700,000</u>	<u>840</u>	<u>\$129,600,000</u>	<u>880</u>	<u>\$135,700,000</u>

## F. CONSTRUCTION COSTS

Construction cost estimates have been prepared in the same manner as described in the May 2 report, taking into account the same factors, including inflation. Construction cost estimate summaries for the alternative June 6 systems are presented herewith. For convenient reference, the summary for the May 2 Routes is also included.

## G. COMPARISON OF MISSION-ALEMANY WITH BAYSHORE FIRST-STAGE PENINSULA ROUTES

The rapid transit program designated as "June 6, 1960 Routes - Peninsula Line via Bayshore" is the same as the system described in the May 2 report, except for modifications in the type of construction proposed for certain segments. The curtailment of the extent of the first stage system in Marin, Contra Costa, Alameda and San Mateo counties has been discussed. It was concluded that the proposed curtailment, with the exception of that of the Peninsula Line, could be made without serious consequences to the functioning of the first-stage rapid transit system.

A special study has been made to disclose the effects on travel time if the construction of the Twin Peaks rapid transit line is postponed. This study is summarized in three time-zone maps of San Francisco and Daly City, which are the affected areas. The maps show zones within which total travel time of a trip by bus, trolley and rapid transit from downtown San Francisco is within the time periods shown on the zone boundaries. In the first zone, travel time is up to ten minutes; in the second zone, from ten to twenty minutes; and in the third zone, from twenty to thirty minutes.

The first such map is predicated on the May 2, 1960 Routes. It is entitled "Geary Line, Bayshore Line, and Twin Peaks Line."

The second map entitled "Geary Line, Bayshore Line, and Underground Trolley Route" shows the time-zone pattern for the June 6 system with the Peninsula Line via Bayshore and with the underground trolley plan in Market Street. This advance construction of part of the Twin Peaks Line provides an underground route for San Francisco trolleys from a point west of Van Ness Avenue through the congested area to a point between First and Second Streets. The time-zone map reflects the improvement in trolley travel time that this underground plan makes possible.

A comparison of these time zone-maps illustrates how well such trolley service utilizing the existing Twin Peaks tunnel approximates, from the point of view of travel time, rapid transit service for the area west of Twin Peaks. This is because trolleys on the K, L and M Lines, which provide convenient pickup in the residential areas, would be expressed with relatively few stops from the western portal of the existing Twin Peaks tunnel to and through the underground trolley routing beneath Market Street. This would be through service requiring no transfer.

It should be noted that even if the Twin Peaks rapid transit line were constructed, most rapid transit patrons from west of Twin Peaks would begin their trips on buses or trolleys feeding that line. A relatively small proportion of the population of the area live within walking distance of a proposed rapid transit station. Moreover, in such high-value property areas, extensive parking facilities are impractical. Thus, for most potential patrons of a Twin Peaks rapid transit line a transfer would be required. This transfer, to a large extent, offsets the faster travel of rapid transit trains compared to express trolleys.

A comparison of the same time-zone maps demonstrates, however, that postponement of construction of rapid transit to Daly City would substantially increase travel time from northern San Mateo County and adjacent areas of San Francisco. It is estimated that by 1975 some 17,000 week-day trips would be made to and from a Peninsula Line rapid transit station in Daly City. It should be noted also that a Twin Peaks rapid transit line does not improve travel time for San Franciscans in the Mission-Alemany corridor.

Because of these deficiencies in service, a regional rapid transit routing through the Mission-Alemany corridor has been developed. The result is the plan designated in this report as "June 6, 1960 Routes - Peninsula Line via Mission-Alemany." This plan proposes construction of the Bayshore Line from Market Street to San Bruno as part of a second-stage program. With this plan, however, there may be no development of a Twin Peaks rapid transit line for regional service.

A time-zone map for this plan is also included and is entitled "Geary Line, Mission-Alemany Line, and Underground Trolley Route." This map is predicated also upon the construction of the underground trolley route as part of the first-stage program. A comparison of the time-zone map for this plan with that involving the Bayshore Route as first stage shows vividly the shortening of travel time to downtown San Francisco from Daly City and northern San Mateo County, and from points within

the City of San Francisco tributary to the Mission-Alemany corridor. Further comparison shows that citizens of the City of San Francisco in the area west of Twin Peaks are practically as well served by the combination of express trolleys and rapid transit through the Mission-Alemany corridor as they would be by a Twin Peaks rapid transit line.

Typical transit travel times between a central point in downtown San Francisco (Market and Montgomery Streets) and outlying points within and near the city, via each of the principal rapid transit alternates, are shown in the following table:

### TOTAL TRAVEL TIME IN MINUTES

<u>Between Downtown San Francisco and the following Intersections</u>	<u>Via May 2 Routes (Including Twin Peaks Rapid Transit)</u>	<u>Via June 6 Routes</u>	
		<u>Peninsula via Bayshore*</u>	<u>Mission- Alemany*</u>
Sunset Blvd. & Taraval St.	27	30	30
San Juan Bautista Circle (Park Merced)	25	33	25
87th St. & Maddux Drive (Daly City)	30	43	25
Mission St. & Ocean Ave.	35	35	21
8th Avenue & Geary Blvd.	18	18	18
South Van Ness Avenue & 22nd Street	25	25	15
Portola Drive & San Pablo Avenue	21	21	21

\* With express trolley operation under Market Street in downtown San Francisco

For patrons living south of San Bruno, where the routes are identical, travel time to the central business district of San Francisco is less than two minutes longer via the Mission-Alemany route, than via the Bayshore route. This time differential is not considered important for the length of trips involved. To some extent it is offset by the convenience that some travellers would find in stations at Daly City, Ocean Avenue, and 22nd Street, compared to stations along the Bayshore route.

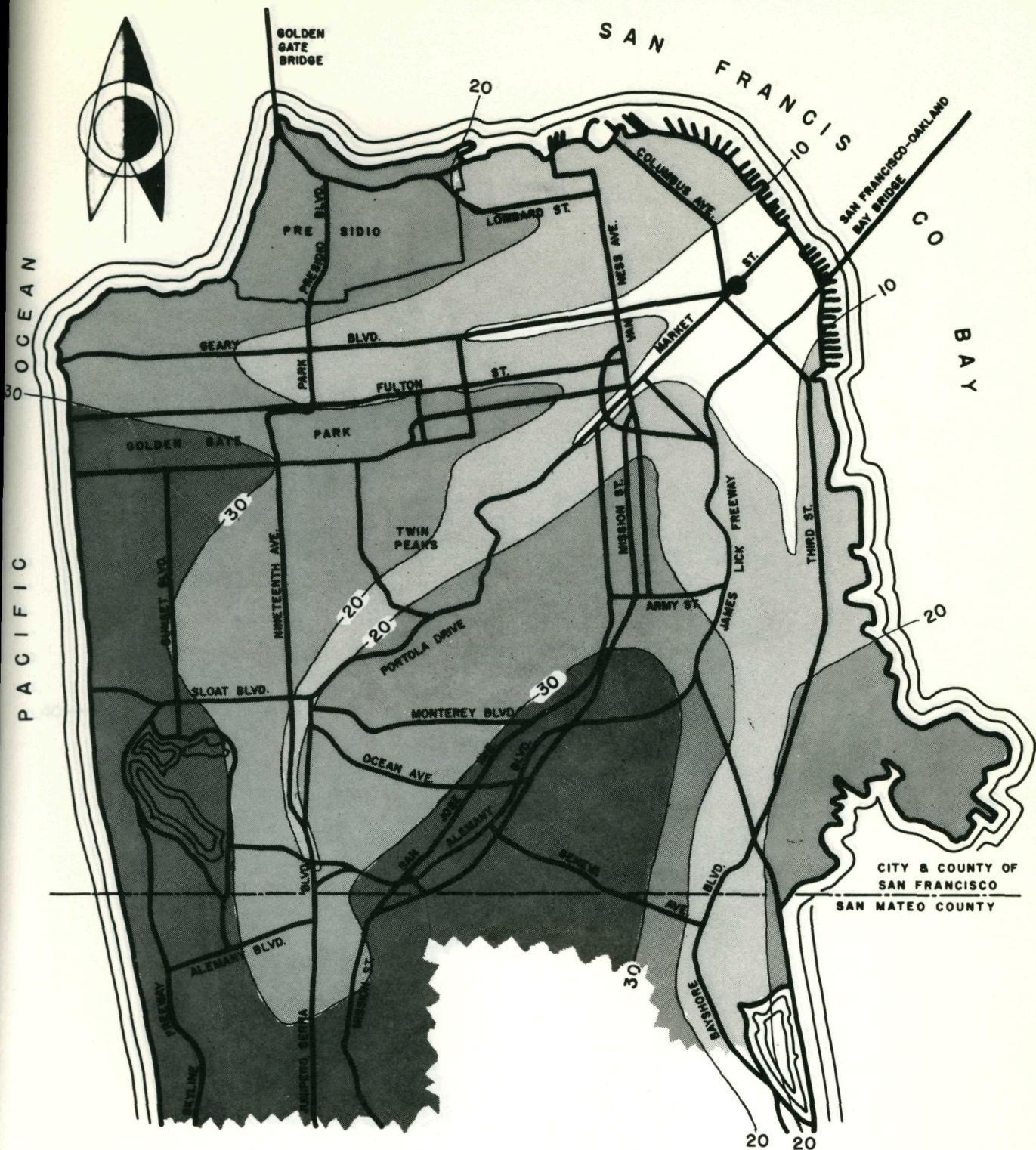
The tables of patronage and net revenue in Part E show that the patronage for the Mission-Aleman route is estimated at approximately 9 percent higher than for the Bayshore route, and net revenues are likewise higher.

From the point of view of regional express transportation it seems clear that if the Bayshore route is constructed in the first stage, the Twin Peaks line might be constructed as a second stage, and there would then be no development of the Mission-Aleman corridor for regional service except perhaps in the long-range future. Should this course be followed, the benefits of shorter travel time, higher patronage, and higher revenue described above for the Mission-Aleman route would not be realized. Conversely, if the Mission-Aleman corridor is developed in the first stage, the Bayshore line could be constructed as a second stage, and there might then be no development of the Twin Peaks corridor for regional service except as a long-range future possibility.

Construction costs compare as follows:

June 6, 1960 Routes - Peninsula Line via Mission-Aleman	915,986,000
June 6, 1960 Routes - Peninsula Line via Bayshore	<u>892,660,000</u>
	23,326,000

It will be noted that the first stage system via the Mission-Aleman corridor is estimated to cost about \$23,000,000 more than a first-stage system via the Bayshore route. This difference, however, will be somewhat more than off-set during construction of the second stage, since the cost of a Twin Peaks rapid transit line would be more than the cost of the Bayshore route from Market Street to San Bruno.



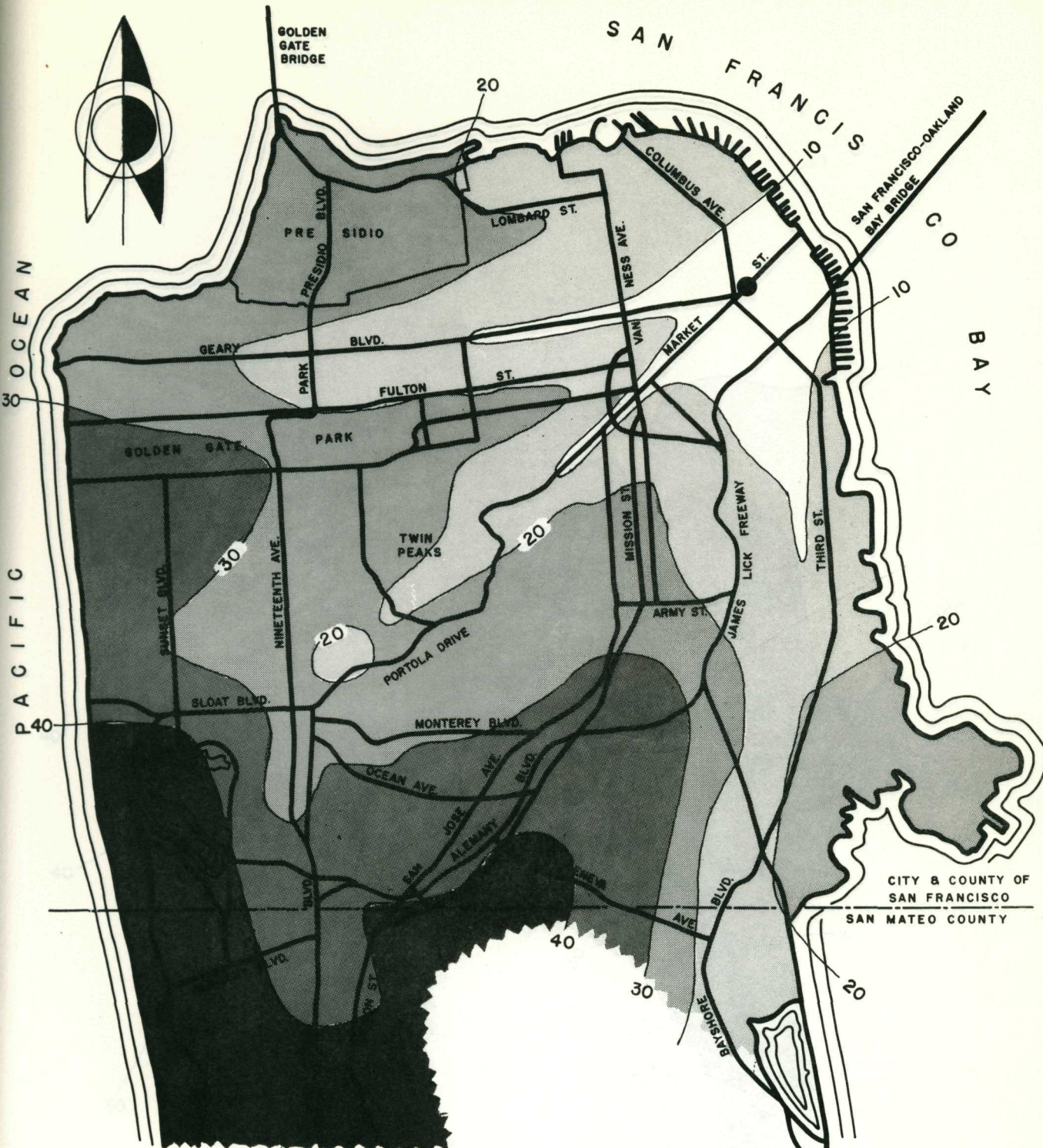
TIMES ARE FROM MARKET STREET AT MONTGOMERY STREET.

RAPID TRANSIT SYSTEM INCLUDES THE MARIN LINE IN GEARY BOULEVARD, THE BAYSHORE PENINSULA LINE, AND THE TWIN PEAKS LINE.

# SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT SAN FRANCISCO AND VICINITY GENERALIZED TRANSIT TRAVEL TIME ZONES

WITH  
 GEARY LINE, BAYSHORE LINE, AND TWIN PEAKS LINE

SCALE: 0 1 2 3 MILES



TIMES ARE FROM MARKET STREET AT MONTGOMERY STREET.

RAPID TRANSIT SYSTEM INCLUDES THE MARIN LINE IN GEARY BOULEVARD AND THE BAYSHORE PENINSULA LINE.

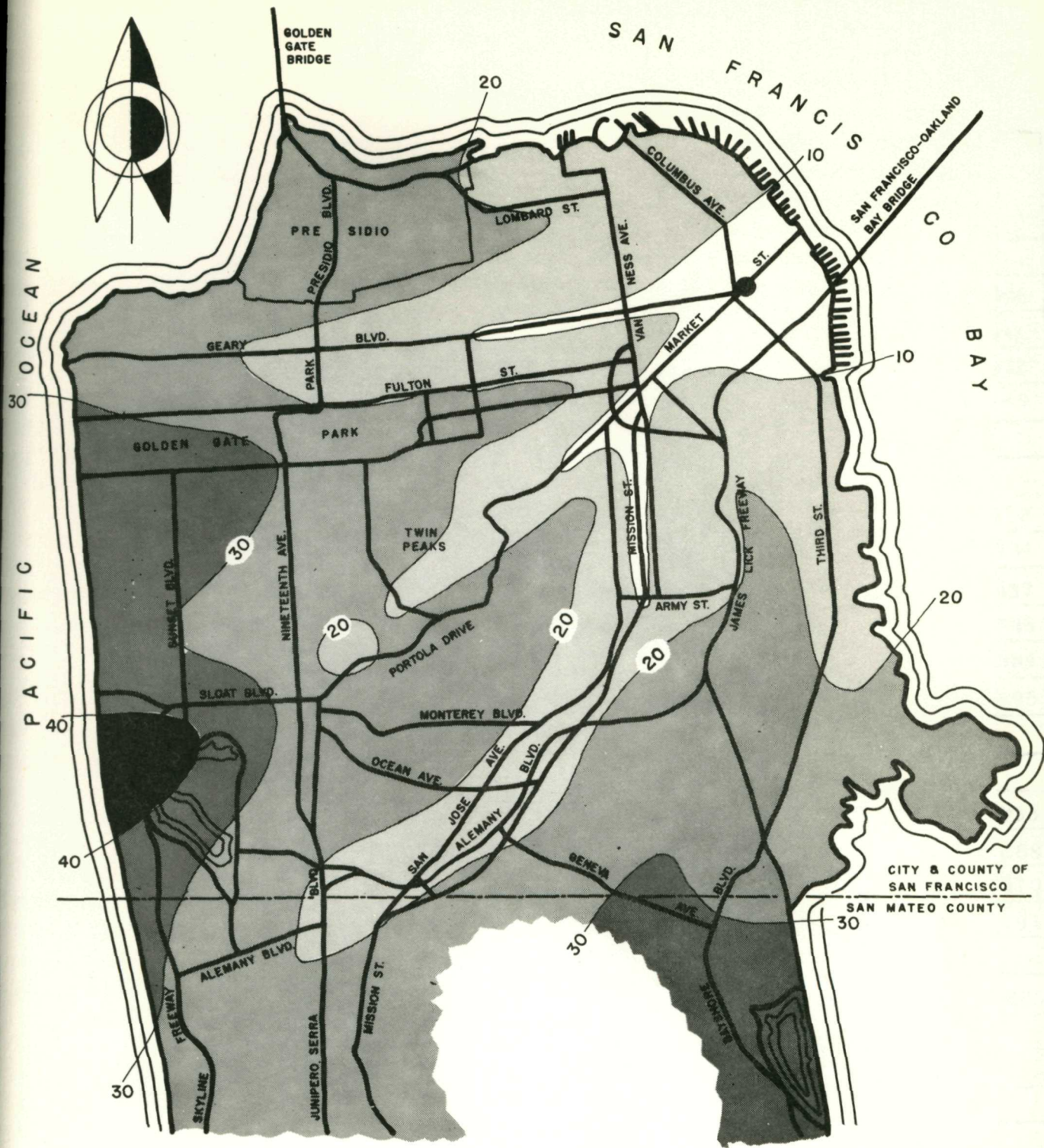
MUNICIPAL RAILWAY INCLUDES THE EXISTING J-K-L-M-N STREET CAR ROUTES IN A DOWNTOWN SUBWAY.

# SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT SAN FRANCISCO AND VICINITY GENERALIZED TRANSIT TRAVEL TIME ZONES

WITH  
GEARY LINE, BAYSHORE LINE, AND  
UNDERGROUND TROLLEY ROUTE

SCALE:





TIMES ARE FROM MARKET STREET AT MONTGOMERY STREET.

RAPID TRANSIT SYSTEM INCLUDES THE MARIN LINE IN GEARY BOULEVARD AND THE MISSION-ALEMANY PENINSULA LINE. MUNICIPAL RAILWAY INCLUDES THE EXISTING J-K-L-M-N STREET CAR ROUTES IN A DOWNTOWN SUBWAY.

# SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT SAN FRANCISCO AND VICINITY

## GENERALIZED TRANSIT TRAVEL TIME ZONES

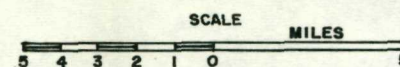
WITH  
GEARY LINE, MISSION-ALEMANY LINE, AND  
UNDERGROUND TROLLEY ROUTE

SCALE: 0 1 2 3 MILES

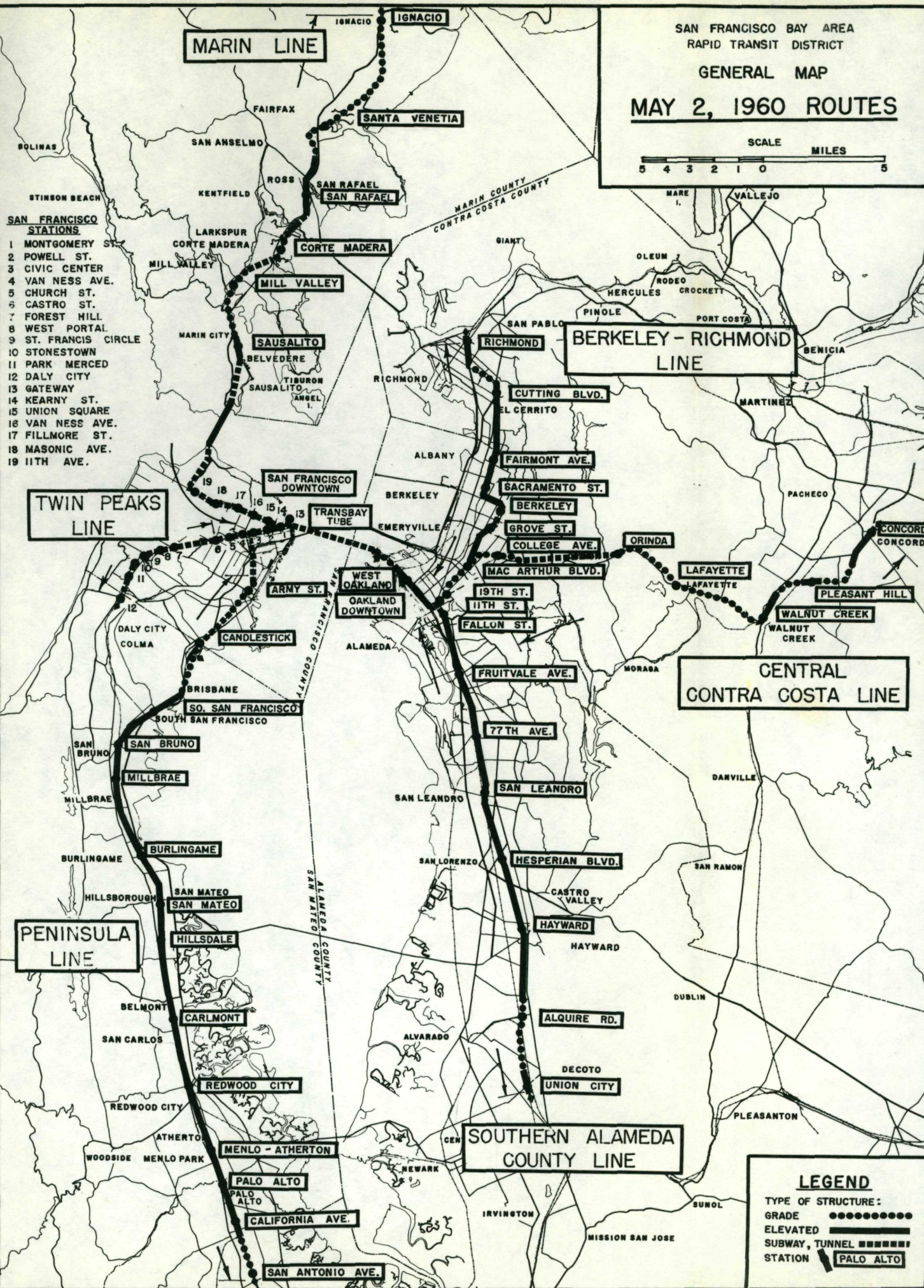
SAN FRANCISCO BAY AREA  
RAPID TRANSIT DISTRICT

GENERAL MAP

MAY 2, 1960 ROUTES

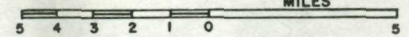


- SAN FRANCISCO STATIONS**
- 1 MONTGOMERY ST.
  - 2 POWELL ST.
  - 3 CIVIC CENTER
  - 4 VAN NESS AVE.
  - 5 CHURCH ST.
  - 6 CASTRO ST.
  - 7 FOREST HILL
  - 8 WEST PORTAL
  - 9 ST. FRANCIS CIRCLE
  - 10 STONESTOWN
  - 11 PARK MERCED
  - 12 DALY CITY
  - 13 GATEWAY
  - 14 KEARNY ST.
  - 15 UNION SQUARE
  - 16 VAN NESS AVE.
  - 17 FILLMORE ST.
  - 18 MASONIC AVE.
  - 19 11TH AVE.



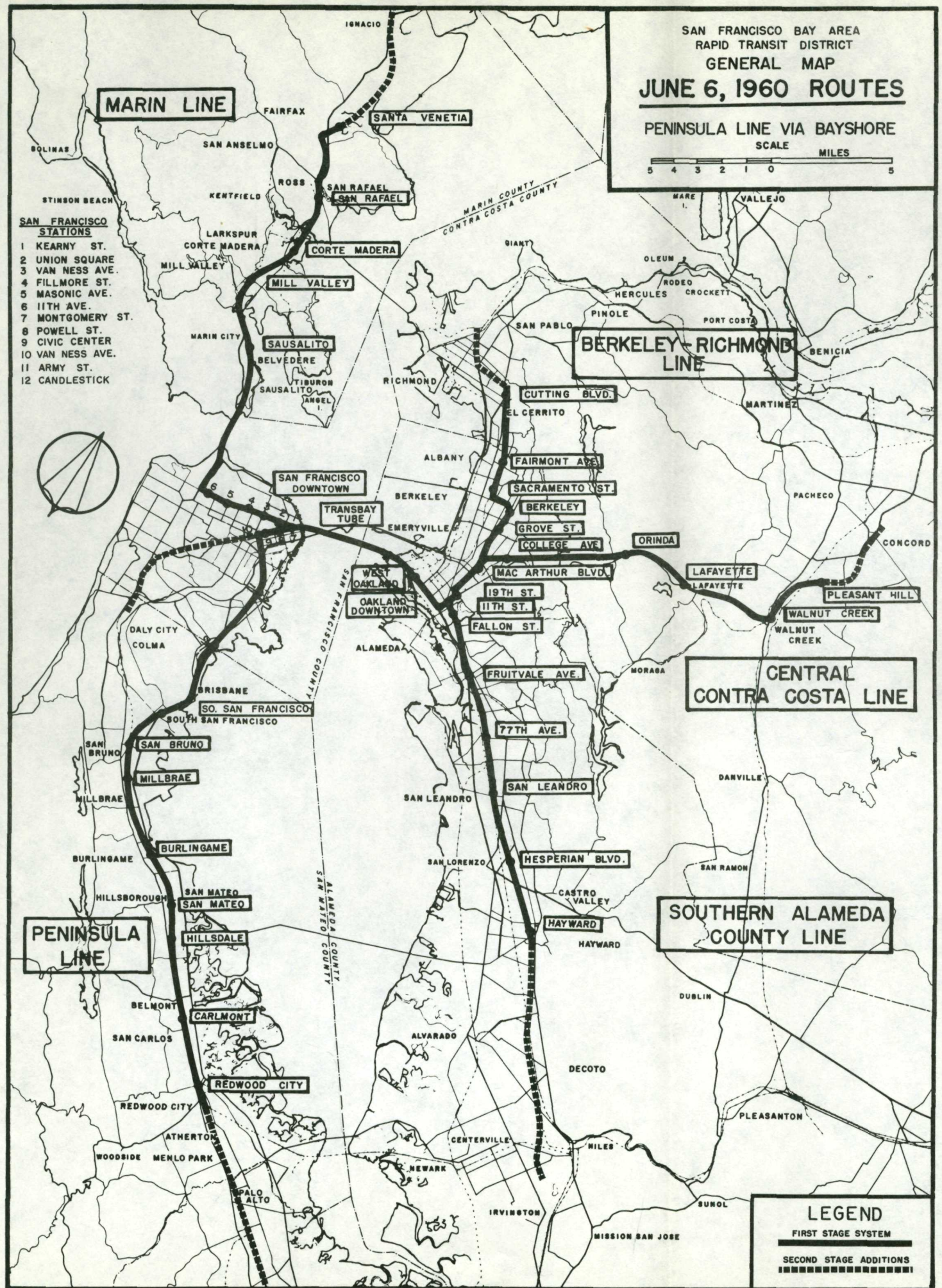
SAN FRANCISCO BAY AREA  
RAPID TRANSIT DISTRICT  
GENERAL MAP  
JUNE 6, 1960 ROUTES

PENINSULA LINE VIA BAYSHORE  
SCALE  
MILES



**SAN FRANCISCO STATIONS**

- 1 KEARNY ST.
- 2 UNION SQUARE
- 3 VAN NESS AVE.
- 4 FILLMORE ST.
- 5 MASONIC AVE.
- 6 11TH AVE.
- 7 MONTGOMERY ST.
- 8 POWELL ST.
- 9 CIVIC CENTER
- 10 VAN NESS AVE.
- 11 ARMY ST.
- 12 CANDLESTICK



**LEGEND**

FIRST STAGE SYSTEM

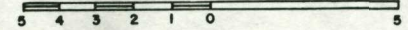
SECOND STAGE ADDITIONS

SAN FRANCISCO BAY AREA  
RAPID TRANSIT DISTRICT  
GENERAL MAP  
**JUNE 6, 1960 ROUTES**

PENINSULA LINE VIA MISSION-ALEMANY

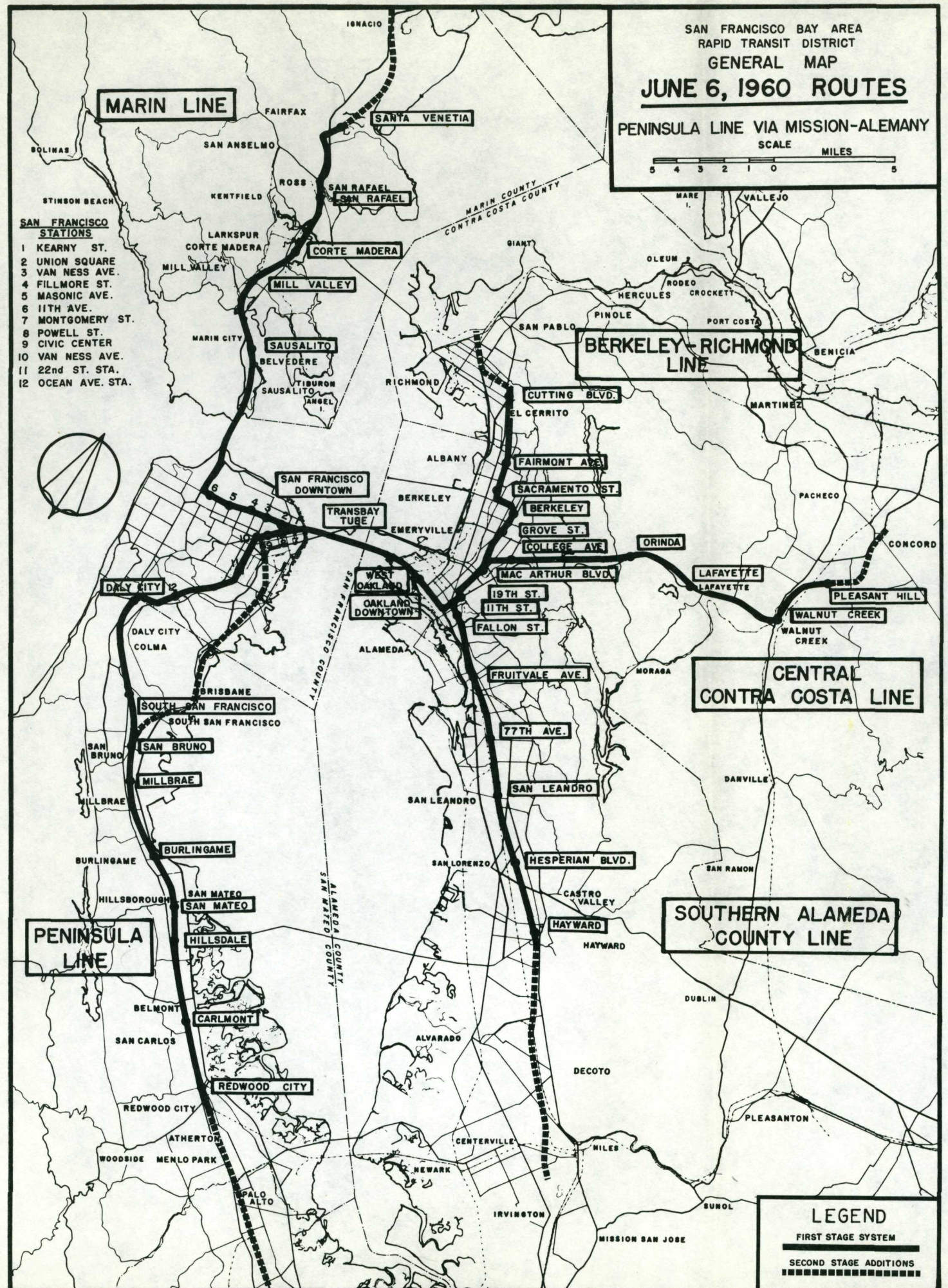
SCALE

MILES



**SAN FRANCISCO STATIONS**

- 1 KEARNY ST.
- 2 UNION SQUARE
- 3 VAN NESS AVE.
- 4 FILLMORE ST.
- 5 MASONIC AVE.
- 6 11TH AVE.
- 7 MONTGOMERY ST.
- 8 POWELL ST.
- 9 CIVIC CENTER
- 10 VAN NESS AVE.
- 11 22nd ST. STA.
- 12 OCEAN AVE. STA.



**LEGEND**

FIRST STAGE SYSTEM

SECOND STAGE ADDITIONS

## APPENDIX A

### REDUCTION OF EXTENT OF RAPID TRANSIT LINES

In accordance with the criteria established in the text, reductions of the extent of the various lines are as follows:

1. Marin Line -- The terminal station is changed from Ignacio to Santa Venetia. The terminal yard is located just beyond the Santa Venetia Station.

This terminal station is just east of Route 101, the Redwood Highway, and can be well served by it from Hamilton Field, Novato, and the general north bay area.

2. Southern Alameda County Line -- This line is shortened from Decoto Road in Union City to the Hayward Station near Jackson Street. Tracks are extended about 2,000 feet along the ultimate route to serve as storage.

The line just penetrates past the most heavily built up part of Hayward. This terminal is served by various combinations of the Nimitz Freeway, Jackson Boulevard, and Mission Boulevard (Route 9) from the south and west. Castro Valley traffic from the east can use either the Jackson Street Station or the Hesperian Boulevard Station to the north.

3. Berkeley-Richmond Line -- This line is shortened to Cutting Boulevard. Since the remaining line to Oakland (and its main yards) is rather short and since there is no easy means of providing area for a terminal yard, no such yard is now planned. Tracks are simply extended about 2,000 feet for storage purposes.

This terminal station is served by a good network of roads. Cutting Boulevard provides east and west access, and the Eastshore Freeway and San Pablo Avenue provide north and south access.

4. Central Contra Costa Line -- Adequate service to Central Contra Costa County for this first stage can be provided with a terminal station and yard facilities at Walden. This involves terminating the line at the Pleasant Hill Station. The terminal yard at the Pleasant Hill Station remains unchanged.

This station is well served by two freeway interchanges providing access generally from all directions.

5. Peninsula Line -- At any terminus of this line, due to its length and operation, a large yard and shop facility is required -- the largest line yard in the system. The need for this yard and its size were prime considerations in determining the new first-stage terminal location. Space and compatible land use for such a yard within reasonable cost is not available near the Southern Pacific R. R. line in Atherton or Menlo Park. North of these communities between the Redwood City Station and Atherton, near the Southern Pacific Redwood Junction, there is property that probably can be acquired at relatively reasonable cost. The yard is planned for this area east of the S. P. R. R. between the Dumbarton Branch tracks and Semi-Circular Road.

A second consideration in determining the terminus was that of accessibility. Adequate access to the Redwood City Station from the south and west is provided by the Bayshore Freeway, El Camino Real, Middlefield Road, and Woodside Road. Access to the Menlo-Atherton Station would not be adequate for a terminal station. Furthermore, a Menlo-Atherton terminal would attract patrons in excess of the capacity of parking facilities that can be provided at reasonable cost considering the land use and values in the area.

These are as described in the May 2 report. However, a significant difference is that the transit line is on grade up at the existing grade of the Southern Pacific Railroad main line tracks.

The following tabulation lists the proposed grade separations for the Southern Pacific Railroad and the Peninsula Line as far south as the Redwood City terminal yard. As indicated in the County report, it is assumed that there are three grade-separated crossings to be built by the State at San Bruno Avenue, Nineteenth Avenue, and Spruce Street. Costs for these are not included in these estimates.

North of San Bruno on the Bayshore Route three additional grade-separations are proposed. The on-grade alternative extends some four miles north of San Bruno since that line is in close proximity to the Southern Pacific Railroad main line tracks and grade crossings do exist.

PENINSULA LINE  
PROPOSED GRADE SEPARATIONS

APPENDIX B

PENINSULA LINE ON-GRADE CONSTRUCTION

As mentioned in the May 2, 1960 report and as described in this report, a study and estimate was made by San Mateo County of a grade-separation program in San Mateo County dealing with the street crossings of both the existing Southern Pacific Railroad and the proposed rapid transit. Grade separations from San Bruno south are dealt with in the report entitled "Grade Separation Study - San Mateo County, California," dated February, 1960 and prepared by Wilsey, Ham & Blair. Reference, therefore, should be made to that report for detail.

Generally, on-grade construction is possible and feasible and is included where the rapid transit tracks are parallel and close to those of the Southern Pacific Railroad main line. The alignment of the Peninsula Line via either Mission-Alemany or Bayshore is the same south of San Bruno, and the line and station locations are as described in the May 2 report. However, a significant difference is that the transit line is on grade or at the existing grade of the Southern Pacific Railroad main line tracks.

The following tabulation lists the proposed grade separations for the Southern Pacific Railroad and the Peninsula Line as far south as the Redwood City terminal yard. As indicated in the County report, it is assumed that there are three grade-separated crossings to be built by the State at San Bruno Avenue, Nineteenth Avenue, and Spruce Street. Costs for these are not included in these estimates.

North of San Bruno on the Bayshore Route three additional grade-separations are proposed. The on-grade alternative extends some four miles north of San Bruno since that line is in close proximity to the Southern Pacific Railroad main line tracks and grade crossings do exist.

**PENINSULA LINE**  
**PROPOSED GRADE SEPARATIONS**

Name and Location of Separation	Separation Type		Alternative Applicable	
	Over	Under	Mission- Alemany	Bayshore
South San Francisco				
Butler Avenue	X			X
East Grand Avenue		X		X
South Linden Avenue		X		X
San Bruno				
Forest Lane	X		X	
Millbrae				
Millwood Drive	X		X	X
Millbrae Avenue	X		X	X
Burlingame				
Broadway	X		X	X
Oak Grove Avenue	X		X	X
Howard Avenue	X		X	X
San Mateo				
Peninsular Avenue	X		X	X
Third Avenue		X	X	X
Fifth Avenue		X	X	X
Ninth Avenue	X		X	X
Saratoga Drive		X	X	X
Hillsdale Boulevard		X	X	X
Belmont				
Ralston Avenue	X		X	X
San Carlos				
Holly Street	X		X	X
Brittan Avenue	X		X	X
Redwood City				
Hopkins Avenue		X	X	X
Brewster Avenue	X		X	X
Jefferson Avenue		X	X	X
Main Street	X		X	X

## APPENDIX C

### PENINSULA LINE VIA BAYSHORE

The general alignment of the Bayshore route of the Peninsula Line is described in the May 2, 1960 report. The estimates herein are for on-grade construction of the Peninsula Line.

One significant change, however, is required to implement the on-grade concept where the transit facilities are in close proximity to the main line tracks of the Southern Pacific Railroad. The on-grade concept of the Bayshore route results in a different alignment and profile between Brisbane and San Bruno.

In the May 2 report, the rapid transit route leaves the Southern Pacific Railroad at Sierra Point and proceeds elevated through South San Francisco and San Bruno. The on-grade alignment, however, continues generally at grade with the Southern Pacific Railroad tracks through South City and San Bruno. At two places in this segment of line the transit tracks rise on aerial structure to permit railroad access to an industrial drill track and sidings and to the San Bruno Branch Line.

There are four existing grade crossings between Brisbane and San Bruno Avenue, and it is necessary to provide grade-separation structures for the railroad and rapid transit at Butler Avenue, East Grand Avenue and South Linden Avenue in South San Francisco. At the fourth grade crossing, Scott Street in San Bruno, the transit line is on structure, crossing over Scott Street and permitting access by the Southern Pacific to their San Bruno Branch Line.

The South San Francisco Station is planned to be just north of East Grand Avenue on the site of the existing Southern Pacific Railroad station.

## APPENDIX D

### PENINSULA LINE VIA MISSION-ALEMANY

A principal alternative route for the Peninsula Line is the Mission-Alemaný corridor generally through San Francisco and northern San Mateo County between Market Street and San Bruno. This segment is alternative to the Bayshore Route which generally follows the route of the Southern Pacific Railroad main line.

Stations in Market Street in San Francisco Downtown are at Montgomery Street, Powell Street, and Civic Center. One other subway station is planned at Van Ness Avenue in Market Street for the streetcar subway line only.

The Peninsula Line leaves Market Street at Van Ness Avenue crossing in subway in private property to Otis Street at McCoppin Street and proceeding to Mission Street. For purposes of this estimate San Francisco Downtown extends to Fourteenth Street on Mission Street. South of that point the estimate of the Peninsula Line begins.

This line continues as subway in Mission Street to the area of the Bernal Cut. A station is proposed at Twenty-Second Street. In the Bernal Cut the line passes beneath San Jose Avenue, tunnels under the highlands south of San Jose Avenue, and emerges beneath St. Mary's Street near Marsilly Street. Crossing on aerial structure over the proposed Southern Freeway and proceeding southward, the line reaches Alemany Boulevard at Lyell Street. From this point the transit line is on aerial structure in Alemany Boulevard practically to the San Mateo County Line. The only exception is at Ocean Avenue where the transit line leaves the center of Alemany Boulevard for the Ocean Avenue Station.

At the intersection of San Jose Avenue and Alemany Boulevard the transit line leaves Alemany Boulevard and follows along the south and east side of the proposed Southern Freeway into Daly City and San Mateo County. The Daly City Station is planned just north of Knowles Avenue.

South of this station the elevated line follows the Southern Pacific San Bruno Branch on the east side of the Southern Pacific Railroad. Near the Southern Pacific Railroad overcrossing of El Camino Real, the transit line crosses over the railroad and enters the right of way of

the old Market Street Railway in the center of El Camino Real. The transit line occupies this right of way to Burlingame Avenue in Burlingame.

The transit line descends to grade after crossing the intersection of El Camino Real and Mission Road in Colma. A yard is located on the Colma-South San Francisco line just north of Chestnut Avenue. The South San Francisco Station is also located here.

Returning to aerial structure, the line proceeds to San Bruno. Near Tanforan Race Track the line returns to grade where it remains generally all the way to the southern terminus, south of Redwood City.

The alignment and stations south of San Bruno are the same as described in the May 2 report. The significant difference is that the transit line is on grade.

Within San Francisco, the line through the Mission District has two alternative routings. One follows the route just described generally along Alemany Boulevard, while the other utilizes part of the route of the proposed Southern Freeway. This latter alternative is now under study and is being presented to the State Division of Highways and to the City of San Francisco for their consideration.

An aerial route along Valencia Street, rather than subway under Mission Street, was earlier considered. None of the existing streets in this area, including Valencia Street, however, are as much as 100 feet wide. This width is considered necessary for aerial construction so as to avoid undesirable effect on the adjacent properties and to maintain proper vehicular surface flow. To widen Valencia Street would be prohibitively expensive and probably unacceptable.

Aerial construction is contemplated in Alemany Boulevard which is 100 feet wide. Although largely residential, high-cost subway construction would be quite disproportionate to the values of the adjacent properties.